1

CATALOG

OF

WARGAMING AND MILITARY

SIMULATION MODELS

12th Edition

7 Feb 92

Force Structure, Resource, and
Assessment Directorate (J-8)
The Joint Staff
Washington, DC 20318-8000

ABSTRACT

The 12th Edition of the Catalog of Wargaming and Military Simulation Models contains descriptions of simulations, war games, exercises, and models in general use throughout the Department of Defense and in the defense establishments of Australia, Canada, England, and Germany. The individual models are listed alphabetically. Each catalog entry includes the date of implementation; the proponent, point of contact, purpose, description, construction, sidedness, and limitations of the model; the improvements and modifications that are planned for the model; the input to and output of the model; the hardware, software, security classification, frequency of use, and users of the model; and general data pertaining to the time requirements of the model.

The catalog draws upon inputs from analysis agencies in the various defense establishments, independent contractors and research organizations, and similar catalogs of games and simulations. The inclusion of a specific model in the catalog is at the discretion of its proponent and does not in any way constitute endorsement of the model by the Force Structure, Resource, and Assessment Directorate (J-8) or the Joint Staff.

CONTENTS

Section	Page

Section	Page

Section	Page

Section	Page

Section | Page

Section	Page

Section | Page

Section	Page

DISPOSITION OF MODELS FROM THE 11TH CATALOG EDITION

AAR - Air Availability and Repair
AASPEM - Air-to-Air System Performance Evaluation Model Support
ABATAK - Air Base Attack Model
ACAAM - Air Courses of Action Assessment Model
ACE - Advanced Campaign Effectiveness Model, Version II, and the Sortie Evaluation (SORVAL) Post-processor
ADB - Aircraft Data Base
ADB - Attrition Data Base for USAF Munitions Planning
ADMRALS - Attack and Defense of Maritime Resources in Adverse Locals Simulator
ADS - Ammunition Distribution System
ADTAM - Air Superior/Air Defense Tanker Analysis Model
AEM - Arsenal Exchange Model **DELETED**
AESOPS
AFP - Army Force Potential
Agile
AIRRAD - Fallout Prediction System
ALARM - Advanced Low Altitude Radar Model
ALARMPP - Pulse-to-Pulse Version of the Advanced Low Altitude Radar Model with Site-Specific Terrain
ALARMSS - Advanced Low Altitude Radar Model with Site-Specific Terrain
ALB-XMOD - AirLand Battle Expert Model
ALEx - Aircraft Loading Expert
ALWSIM III - Army Laser Weapon Simulation Model
AMM - Advanced Missile Model
AMM - Army Mobility Model
ANGEL - Aids to Navigation Event-Step Logistics Model
APM - Advanced Penetration Model
Application of Error Analysis to Target Location System
APS - Ammunition Point Simulation **DELETED**
ARTBASS- ARmy Training BAttle Simulation System
ARTOAR - Attack Helicopter Air-to-Air Fire Control System Simulation Model
ASESS - Air Strike/Engagement Spread Sheet
ASOAR - Achieving a System Operational Availability Requirement
ASOSM - A Sub on Sub Model
ASUMS - Aircraft Survivability with Missiles and Stealth
ATTACK Model
AURA - Army Unit Resiliency Analysis
Automated FIRST BATTLE - Battalion - Corps **DELETED**
AWM - Amphibious Warfare Model
AWSIMS - Air Warfare Simulation System

Balboa - Aerospace Employment Exercise
BALFRAM - Balanaced Force Requirements Analysis Methodology
BBS (COMBAT-SIM)
BEST WEAPON
BETA
Big Stick **DELETED**
BLDM - Battalion Level Differential Model
BLOCKBUSTER
BLUEMAX II (Flight Path Generator)
BODESIM - Barrier/Obstacle Deployment and Effectiveness Simulation Model
BONeS - Block Oriented Network Simulator
Bottom Line
BPS - Battle Planning System

BRLFCS - Ballistic Research Laboratory Firepower Control
System DELE
Buildup

CAMMS - Condensed Army Mobility Model System
CAMP · Computer Assisted Match Program DELETED
CAM-X - Corps Ammunition Model Expanded
Canadian Land Forces Research War Game
CASMO - Combat Analysis Sustainability Model
CASTFOREM - Combat Arms Task Force Engagement Model
CBAM - Combat Base Assessment Model
CCBM - Generic Crew-Centered Bomber Mission Model
CCOMEM - Conventional Collateral Mission Effectiveness Model
CEM - Concepts Evaluation Model
CEOPS - Communication-Electronics Operator Positioning System DELETED
CFARC - Cloud-Free Arc Simulator
CFAW - Contingency Force Analysis Wargame
CHEMCAS III - Chemical Casualty III
CISCIAD - Combat Identification System COMO Integrated Air
Defense
CLDGEN - Cloud Scene Simulator
COMBAT IV
Combat Model ELAN+
COMET - Calculation of Missile Earth Trajectories
COM/EW - Tactical Communications/Electronic Warfare
COMMANDER V - Tactical Air/Land/Naval Operations Model
COMO III- Air Defense Computer Modeling System
COMO ADC3- COMO Air Defense C3 Model
COMO(T)- Computer Model
ConMod - Conflict Model
CORBAN - Corps Battle Analyzer
Correlation of Forces Model
COSAGE V - Combat Sample Generator
COSYCAT - Combat System Capability Evaluation Tool
CRASOF - Combat Rescue and Special Operations Forces
CRUISE_Missiles - C-Based Routines for Understanding
Interaction Between Ships, EW, and Missiles
CVOF - Ceiling and Visibility Observation/Forecast
CWASAR - Cruise Weapon Analysis Simulation and Research

D2PC - Downwind Chemical Hazard
DAP - Data Analysis Package
DART Family of Survivability Models
DEPLOY - Deployment and Sustainment Model
DESCEM - Dynamic Electromagnetic Systems Combat Effectiveness Model
DETCONT - Detection Contour Program
DETEC - Defense Technology Evaluation Code
DEWCOM - Divisional Electronic Warfare Combat Model
DIDSIM - Defense-In-Depth Simulation
DIVLEV - AMSAA Division Level Wargame
DNYPSIM - Wind/Pasquill Stability SImulator
Dunn Kempf
DWG - Divisional War Game

Eagle - Corps/Division Analysis Model
ECECE - Electronic Combat Equipment Capabilities Evaluation
EDECSIM - Extended Directed Energy Combat Simulation
E-EFAM - Expanded Engineer Functional Area Model
EIEM - Electromagnetic Interference Effects Model
EMSA - Electronic Warfare Multiple Sensor Analysis
End-Game
Engage

EOVAC - Electro Optical Vulnerability Assessment Code
Error Analysis Using Multiple Ellipse Techniques for Use on Airborne Vehicles
ESAMS - Enhanced Surface-to-Air Missile Simulation
EWS - Electronic Warfare Simulation

FACTS - Fleet AAW Model for Comparison of Tactical Systems
FASTALS - Force Analysis Simulation of Theater, Administrative and Logistics Support
Fast Stick
FDM - Force Design Model **DELETED**
FIRST FORAY (Revised Edition)
FLAPS - Force Level Automated Planning System
FOF - Follow On Forces Model
FORCEM - Force Evaluation Model
FORCOST - Force Costing Model
FORGE - The Force Generation Model **DELETED**
FORGE - FORCEM Gaming Evaluator Model **DELETED**
FPM - Force Planning Model (training and education) **DELETED**
FPM - Forces Planning Model (analysis model) **DELETED**
Frequency Hopping Model (including cosite variation)
FROBAK - Front End-Back End
FSTAM - Force Strucutre Trade-Off Analysis Model

G2WS - G2 Workstation
GEMM - Generic Missile Model
GEMMTLCM - GEMM with Tracking Loops and Counter-Measure
GENSAW - User-Assisted Generic Systems Analysis Workstation
GIFT - Geometric Information for Targets **DELETED**
GRWSIM - Ground Warfare Simulation
GUNFIRE - Air-to-AIr Gun Program

HELSCAM - Helicopter Scenario Assessment Model
HOME - Homing Missile Engagements

JAGUAR - Juego de Guerra Aereo Americano Regional
Janus 4
JANUS/R
JANUS(T)
JAWS - Joint AFSC Wargaming System
JAWS - Joint Analytic Warfare Systems **DELETED**
JC3S - Joint C3 Simulation
JESS - Joint Exercise Support System **DELETED**
JPLAN & RADEX - Joint Planning Exercise & Rapid Deployment Exercise
JTIDSC2 - Joint Tactical Information Distribution System Class 2 Terminal Network Simulation Model
JTLS - Joint Theater Level Simulation

Kinematics

LABS - Local Air Battle Simulation
LDM - Logistics Decision Model
LFMD/AMIP - Logistics Functional Model Development for Army Improvement Program
LOCNES - Lock-on Range Calculation Needed in Electro-Optical Simulation
LOEM - Launcher Orders Evaluation Model
LOGATAK III - Logistics System Attack III
LOGNET - Logistics Data Network
Low Intensity Conflict Gaming System **DELETED**
LOWTRAN 7

LRSAMP - Long Range Strategic Appraisal and Military Planning System

MABS-EX - Mixed Air Battle Simulator - Extended
MACATAK - Maintenance Capabilities Attack Model
MACRO - Model of Aggregated Central Region Operations
MACRO-2 - Model of Aggregated Central Region Operations
MARGI-SIOP - Strategic Air Command Methodology for Analyzing Reliability and Maintainability Goals and Investments
MARGI-TAC - Methodology for Analyzing Reliability and Maintainability Goals and Investments for Tactical Air Forces
Markov Survivability Model
MASS - Mobility Analysis Support System
MATADOR
MAWLOGS - Models of the Army Worldwide Logistics System
MAWM - Modular Air War Model
MBCS - Minefields and Barriers Combat Simulation
MEM - Mission Effectiveness Model
MEM - Multiple Engagement Model
MICA - Multiple Launch Rocket System (MLRS) Interactive Computer Aid
Micro-FASTALS - Microcomputer Force Analysis Simulation of Theater, Adminstrative and Logistics Support
Micro-PFM - Microcomputer Patient Flow Model **DELETED**
Micro SAINT
MIDAS - Macintosh Interactive Display and Analysis System
MIDLAAM - Midlevel Allocation and Assessment Model
MINDSIM - Mine Deployment Simulation Model
Minotaur
MME - Mobilization Model
MPRES - Method for Presenting Received Signals
MRM - Medical Regulating Model
MSEPAM - Mobile Subscriber Equipment Performance Analysis Model
MULTI-ASPIC - Multiple AWACS Simulation: Pentrator/Interceptor Combat Model
MULTIWAR - Multiwarfare Scoping Model Version 2.0
MUPPET - Multi-Purpose Performance Evaluation Tool

NADM - NORAD Air Defense Model
NAM - Network Assessment Model
NAVMOD - Naval Model
NEST - Naval Exercise Support Tool
NETS - Netted EW/GCI Tracking System Model
NETSIM - Network Simulation Model **DELETED**
Network II.5 **DELETED**
NMSTPA - Naval Minesweeping Tactical Planning Aid
NRMM - NATO Reference Mobility Model
N-SNAP - Non-Strategic Nuclear Attack Planning
NUC-STRATEGYST
NUCWAVE - Nuclear Wave Attck System Model
NUFAM III - Nuclear Fire Planning and Assessment Model III
NUSSE-3 & NUSSE-3 (ATM)

OBSERVE - Laser Observation Program
OPSURV - Operational Survivability Model
OPUS1 - Optimal Preferential Utility and Strategies Program, Version 1
ORDAM - Obstacle Removal Delay Assessment Model
OSADS - Optical Signature Acquisition and Detection Model
OSAMM - Optimum Supply and Maintenance Model

P001 - Anti-Aircraft Artillery Simulation Computer Program
PACES - Performance Analysis for Communications-Electronics Systems
PANTHER - Low Intensity Conflict (LIC) Simulation **DELETED**
PARACOMPT - Parametric Analysis of Respiratory Agents Considering Operations, Motivations, Protection and Time
PASTE - Penetration ASsessment of Terminal Engagements
PATROL
PAWS - Parametric Assessment of Weapons Systems
PEJ Propagation Model - PLRS/EPLRS/JTIDS Propagation Model **DELETED**
PIVADS - Product Improved Vulcan Air Defense System Effectiveness Model
PLRS/EPLRS Deployment Aids - Connectivity Model
POL - Petroleum, Oil, Lubricants Model
PROLOGUE - Planning Resources of Logistics Units Evaluators

QJM - Quantified Judgement Model

Radar Workstation
RADGUNS - RAdar Directed GUN System Simulation
RAPIDSIM - Rapid Intertheater Deployment Simulation Model
RCN - Radio Communications Network Model **DELETED**
RECCE - Reconnaissance Mission Planning Aid
RESA - Research, Evaluation, and Systems Analysis Facility
RETCOM - Return to Combat
REVAM - RPV EW Vulnerability Assessment Model
RSAS - Rand Strategy Assessment System
RWAM - Revised Weapon Allocation Model **DELETED**

SAAMBO - Signature of Air-to-Air Missiles after Burnout
SAB - Surface-Air Battle
SAR - Search and Rescue
SAS **DELETED**
SCARE - Simulation and Countermeasure, Aircraft, and Radar Encounters
SCAT - Sea Control Analysis Tool
SEABAT - Sea Battle Model
SEAT - Strategic Engagement Analysis Tool
SEES 1.1 - Security Exercise Evaluation Simulation Ver 1.1
SFEM - Space Forces Engagement Model
SHIPDAM - Ship Damage Model
SIDAC - Single Integrated Damage Analysis Capability
SIM II Naval Warfare Engagement Simulation
SINBAC - Systems for Integrated Nuclear Battle Analysis Calculus
SITAP - Simulation for Transportation Analysis and Planning
SLAVE - Simple Lethality and Vulnerability Estimator **DELETED**
SLIC - Simple Low Intensity Conflict Assessment Model
SNAP - Strategic Nuclear Attack Planning
SODSIM - Strategic Offense/Defense Simulation
SOJ - Stand-Off Jamming
SOTACA - State-Of-The-Art Contingency Analysis
Soviet Troop Control Air Model **DELETED**
Space CEM - Space Communications Effectiveness Model
SPAM - Self-Protection Analysis Model
SPAN - Signal Parametric Analysis of Potential Critical Nodes
SPEED84 - Simulation of Penetrators Encountering Extensive Defense
SPIRITS - Spectral Infrared Imaging of Targets and Scenes
SRBS - Skeletal Reference Baseline System
STAIR - Simulation of Tactical Airborne Interceptor Radar
STAM - SIOP Tanker Analysis Model
STAT - Strategic Transportation Analysis Tool
STEWS - Simulation of Total Electronic Warfare Systems
STOCHADE
STRATC2AM - Strategic Command Control Architecture Model

STRAT DEFENDER Model
STRAT PATROLLER Model
STRAT RANGE
STRAT SURVIVOR
Strike
STRIKER - Tomahawk Land Attack Effectiveness Simulation
Sub-on-Sub
Suppressor
SUWAM - Strategic Unconventional Warfare Assessment Model
SWARM - Strategic Warning and Response Model
SWATEM - Small-Force Weapons and Tactics Evaluation Model

TACAP - Tactical Air Command Aircraft Patroller
TAC Brawler
TACEM - Tactical Aircraft Engagement Model
TACOPS - Theater and Corps Operations Planning Simulation II **DELETED**
TAC RANGER
TAC REPELLER
TAC SABER
TAC SELECTOR
TACSIM - Tactical Simulation
TAC THUNDER
TAC THUNDER Intratheater Logistics Module
TACWAR - Tactical Warfare
TACWARS - TACAIR Warfare Simulation **DELETED**
TACWAR/STC - Tactical Warfare **DELETED**
TAC WEAPONEER II
TAFSM - Target Acquisition Fire Support Model
TAGS - Technology for the Automated Generation of Systems
TALCCM - Tactical Airlift Control Center Model
TAM - Theater Analysis Model
Tank Wars II - The Sustained Combat Model
TAPM - Tactical Aircraft Penetration Model
TARA - Target Acquisition and Risk Assessment
TAWS - Theatre Air Wargaming System
TECH/MAP- Time Evaluation of Casualty History
TEM - Terrain Effects Model
TimeLine Analysis Model
TIS - Thermal Imaging System Program
TMDC3ISIM - Tactical Missile Defense Command, Control, Communications, and Intelligence Simulation
Tomahawk
Total Force Manpower Tradeoff Model
TOTAL ROUND - Total Round Standard Missile Simulation
TRANATAK - Transporation Network Attack
TRANSACT - Transportation and Supply Activities
TRANSMO - Transportation Model
TRICIA - Theater Attrition Model
TSAR - Theater Simulation of Airbase Resources
TSARINA - Theater Simulation of Airbase Resources INputs using Airbase Damage Assessment Model
TTSM - Theater Transition and Sustainment Model
TW/AA End-to-End Model
TWSEAS-IMC - Tactical Warfare Simulation, Evaluation and Analysis System - Integrated Manuever Controller

URBAT - Urban Battle Trainer
UVWR - UltraViolet Warning Receiver Detection Range

VAST - Vulnerability Analysis for Surface Targets
VECTOR-3
VEDER - Visual/Electro-Optical Detection Range Model

VEHW - Vehicle Weathering Model
VGCUFS - Vehicle Gap Crossing Under Fire Simulation
VIBAS - Village Battle Simulation **DELETED**
VIC - Vector In Commander
Visual Search
VOLUME - Engageability Volume Model Graphic Display

WAAM - Worldwide Military Command and Control System (WWMCCS) Allocation and Assessment Model
WAM - Weapon Assessment Model
WEBS - Weapons Effectiveness Battle Simulation
WEIGHT **DELETED**

XSTAR

YAC - Yet Another CHEMCAS

TITLE: AAA TTF - AAA Target Tracking Function.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze radar response to applied ECM.

DESCRIPTION: AAA TTF analyzes radar response to ECM by modeling the pertinent radar functions (az & el channels with IF filtering and error discrimination) at the analog block level. The target geometry and antenna pattern generator is also in the modeled loop.

INPUT: CSMP Model. User-supplied FORTRAN ECM routines.

OUTPUT: Azimuth and elevation tracking errors.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780-782. Requires array processor.
- Storage: 50K Bytes; memory requirements: 1M Bytes.
- Language: FORTRAN IV-Plus.
- Documentation: None.

SECURITY CLASSIFICATION: Program Code is unclassified; input data is Secret.

GENERAL DATA:
- Data Base: Preparation time is 2 days.
- CPU time per Cycle: 5 minutes on VAX computer.
- Comments: Status of Model - completed; debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: AAPG - Aircraft Inter-Antenna Propagation with Graphics.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: AAPG is a research and evaluation tool that uses interactive computer graphics to assist in the analysis of antenna-to-antenna electromagnetic interference for subsystems on an aircraft. Cosite and limited intersite applications are possible. The program calculates the levels of antenna-to-antenna transmitter power at the receivers that are frequency-coincident with a transmitter fundamental or harmonic frequency. Version 09 of AAPG allows for more realistic modeling of aircraft fuselages than did previous versions of the program. The geodesics over airframes technique is used to compute geodesic paths between antennas, and uniform theory of diffraction techniques have been implemented to calculate surface diffractions over shapes of greater generality. Antenna-to-antenna coupling calculations include free-space propagation loss, surface shading over the aircraft fuselage, and knife-edge diffraction over the wing edges. Simple models for the transmitter spectrum, receiver selectivity, and antenna pattern are used in the calculation.

DESCRIPTION:

Domain: Land and air aircraft operation.

Span: Global.

Environment: Aircraft Frame.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Communications.

Level of Detail of Processes and Entities: Communications subsystems on an aircraft.

CONSTRUCTION:

Human Participation: Required to acquire information for data input and select decisions.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: Frequency range for input 150-20000 MHz; aircraft geometry must be a cylinder with cones at each end and cross-sections of shapes with slowly varying radius of curvature. Wings are modeled as flat plates.

PLANNED IMPROVEMENTS AND MODIFICATIONS: More user-friendly input methods.

INPUT: Data needed include aircraft geometry, antenna locations and C-E system characteristics.

OUTPUT: Displays and printouts of data and results. Graphic display of aircraft and coupling path.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS, IBM-compatible PC.
Storage:	At least 640K RAM (PC).
Peripherals:	Printer (VAX), Tektronix (VAX), HP LaserJet or Epson Fx compatible printer (PC).
Language:	FORTRAN.
Documentation:	User's Manual for Aircraft Inter-Antenna Propagation with Graphics (AAPG) Computer Program, Version 09, Hussar, Dr. Paul E. and Klocko, William R.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Varies.

CPU time per Cycle: Varies.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Varies by command.

Users: DoD, ECAC, ASD/ENACE, Naval Air Test Center, ASD/YFFA.

Comments: None.

TITLE: AAR - Air Availability and Repair.

DATE IMPLEMENTED: September 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: AAR models air combat sustainability and aircraft battle damage repair rates. It is designed to provide logistical input to larger-scale war games.

DESCRIPTION:
Domain: Land and sea.

Span: Theater.

Environment: N/A.

Force Composition: Theater-level aircraft groups and wings.

Scope of Conflict: N/A.

Mission Area: Logistics.

Level of Detail of Processes and Entities: Users define aircraft type and quantities, as well as mission, airfield (including attack aircraft carriers), and depot capabilities. Users supply attrition, damage, and repair rates.

CONSTRUCTION:
Human Participation: Required for initial inputs only.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Stochastic, with Monte Carlo determination of result.

Sidedness: One-sided.

LIMITATIONS: AAR assumes repaired aircraft are fully mission capable and does not identify the type or extent of damage. User input intensive.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Aircraft quantity, type, location, and mission; attrition, damage, and repair rates as function of mission and aircraft type; spares kit availability; airfield or depot location; repair priorities and capabilities; day/times of missions; and aircraft/kit movements.

OUTPUT: Detailed mission summary reports by target, airfield, and aircraft type. Reports are by days and may be specified for first and last days of campaign or for each day.

HARDWARE AND SOFTWARE:
Computer: Dual drive IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: N/A.
Language: FORTRAN.
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One hour.

CPU time per Cycle: N/A.

Data Output Analysis: Detailed mission summary reports by target, aircraft, and airfield.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: AAR is based on algorithms presented by Major J.F. Torsak, USMC, in "Aircraft Battle Damage Repair, Global Wargame 86 - Exploring the Strategic Alternatives," NWC 09-87. It is used to provide aircraft logistics input to larger-scale war games.

TITLE: AARAD - Attack Assessment Radar.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis.

PROPONENT: HQ AFSPACECOM/CNF.

POINT OF CONTACT: Mr. Jesse Conti, 554-5465; Mr. Steve James, 554-3589.

PURPOSE: AARAD simulation is a self-contained, pulse-by-pulse radar simulation in which the phased array radar and its associated data processor interact with a ballistic missile attack with a satellite background. It provides an analysis tool for evaluating the PAVE PAWS and BMEWS (site 1 & 3) radars in the roles of missile surveillance, attack assessment, and SPACETRACK. These roles include the detecting and tracking of SLBMs and ICBMs to alert U.S. command and control elements (i.e., Tactical Warning) and to characterize the missile attack (i.e., Attack Assessment).

DESCRIPTION:

Domain: Land and Space.

Span: Global.

Environment: Models ICBM and SLBM threat and satellite trajectories. The radar hardware simulation models the radar system components, the physical environment encountered by the pulse transmission, and the threat disposition at the time of transmission. The data processor simulation models the tactical algorithms that support its missile warning and SPACETRACK functions.

Force Composition: Red ICBMs and SLBMs; Blue PAVE PAWS and BMEWS Radars (site 1 and two faces of site 3).

Scope of Conflict: ICBMs and SLBMs against CONUS, Pacific targets and Europe.

Mission Area: Missile Tactical Warning and Attack Assessment.

Level of Detail of Processes and Entities: The threat can be 1 ICBM/SLBM or a large raid containing 10,000 objects. Target characteristics include state vectors for all objects in the scenario (i.e., tanks, PBVs RVs, other), ballistic coefficients, radar cross section for each object, and satellite orbital element sets. The radar simulation is a high fidelity model that simulates the radar's operation pulse by pulse.

CONSTRUCTION:

Human Participation: Required for process.

Time Processing: Dynamic, time-stepped model.

Treatment of Randomness: Direct Computation.

Sidedness: One-sided; measures the radar system against a missile raid scenario.

LIMITATIONS: 10,000 object raid.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrades to reflect the PAVE PAWS upgrades and the BMEWS Site III upgrade.

INPUT: Threat modeled by using state vectors at time of separation or burnout for each object of interest (i.e., tank, PBV, RV, other). Radar parameters are set according to specific site values and may be changed by user.

OUTPUT: Produces printout of objects detected, missile message generation, radar performance data, dropped track data, radar/object encounter data, target counts within a specified range area, object detection history, uncorrupted measurement data, unknown satellites orbital element sets, known satellites time off orbital element sets, output message file, and debug information file.

HARDWARE AND SOFTWARE:

Computer:	VAX.
Storage:	240,000 blocks.
Peripherals:	1 Terminal, 1 Printer.
Language:	SIMULTRAN/FORTRAN.
Documentation:	Documented in 8 manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Depends on size of scenario; 1 to 5 days.

CPU time per Cycle: Depends on size of scenario; 5 to 50 CPU hours.

Data Output Analysis: Days to months depending on specific requirements.

Frequency of Use: Varies by Command Taskings.

Users: HQ AFSPACECOM.

Comments: None.

TITLE: AASPEM - Air-to-Air System Performance Evaluation.

DATE IMPLEMENTED: July 1990.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: AASPEM is an engagement level model designed to evaluate aircraft and their associated weapon systems in a tactical combat environment.

DESCRIPTION:
Domain: Air.

Span: Mission.

Environment: Air engagement only, terrain and weather not modeled.

Force Composition: Opposing flights of aircraft.

Scope of Conflict: Conventional weapons.

Mission Area: Counterair.

Level of Detail of Processes and Entities: The following subsystems are modeled: aerodynamic characteristics, propulsion systems, signature, and avionics of each aircraft; the seekers, guidance, aeropropulsion, and endgame lethality of each missile type; and the fire control system and lethality for each gun type. Three levels of detail can be modeled for each aircraft sensor.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-step and event-step model.

Treatment of Randomness: Air attrition stochastically based on direct computation of probability of detection and probability of kill with Monte Carlo determination of result.

Sidedness: AASPEM is a two-sided asymmetric model in which both sides are reactive.

LIMITATIONS: Requires a computer with virtual memory. Can run up to 24 aircraft and 75 vehicles.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Control and scenario parameter inputs, aircraft performance data, aircraft sensor data, radar and ECM data, jammer data, aircraft thrust data, aircraft fuel flow data, aircraft aero data, missile performance data, missile guidance data, missile aero data, firing screen data, detection contours, missile Pk data, WVR tactics data, pilot decision logic, EW threat data, and initial conditions.

OUTPUT: Reflected inputs, narrative of events, missile trajectory, aircraft desired parameters, internal program error report, specific excess power curves, pilot decisions RED and BLUE, engagement summary, and mission profile calculation.

HARDWARE AND SOFTWARE:

Computer:	Currently run on APOLLO, VAX, and MicroVAX computers.
Storage:	9.975 blocks needed before data base installed.
Peripherals:	Printer, graphics terminal, and graphics hardcopy unit.
Language:	FORTRAN 77.
Documentation:	AASPEM Programmer's Manual and AASPEM User's Manual

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Highly dependent on how much problem varies from previous study. Building entirely new missile, aircraft, and sensor files could take several man-years.

CPU time per Cycle: Average run time varies with scenario size and computer equipment; a typical engagement of 12 aircraft runs on a MicroVAX II in about 30 minutes of CPU time.

Data Output Analysis: AASPEM has an interactive graphic display of air-to-air battle. Many output files can be specified and programs are available to summarize and analyze data.

Frequency of Use:

Users: Engineering/Analysis Support AD/XRY, Foreign Technology Division FTD/TQIQ, HQ Strategic Air Command SIW/DIA, Aeronautical Systems Division ASD/XRM, and several government contractors.

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: AAT - Architecture Assessment Tool.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis (telecommunications architectures/technology).

PROPONENT: Joint Tactical C3 Agency, ATTN: TB, Ft. Monmouth, NJ 07703-5613.

POINT OF CONTACT: Mr. Salvatore Manno, DSN 992-7706, CML (908) 532-7706.

PURPOSE: The AAT has been developed for, and in conjunction with, the nine nations participating in Project Group 6 (PG/6) of the NATO Tri-Service Group on Communications-Electronics. The purpose of the AAT is to assist in assessing post 2000 communications architectures for up to a corps-sized force. The AAT includes models of wide area networks (packet and circuit switches, fast packet switching using ATM, etc.), local area networks (ethernet and dual queue/dual bus), and mobile networks (multirole radio with mobile telephone and combat net radio functions). The AAT is designed to provide measures of performance and measures of effectiveness.

DESCRIPTION:
Domain: Land.

Span: Theater, can address areas supported by Defense Mapping Agency terrain data.

Environment: Uses Defense Mapping Agency digitized terrain data.

Force Composition: Joint and combined forces, blue only.

Scope of Conflict: Physical event script can include effects of physical destruction and jamming on the communications structure.

Mission Area: Communications architecture in support of up to a corps sized force.

Detail of Level of Processes and Entities: The AAT can simulate entities as low as individual voice calls and data packets that are transmitted and received on communications links. The AAT can also simulate the movement of individual mobile users, allow the user to reconfigure networks, and simulate various types of transmission media (e.g., HF, VHF, SATCOM). Processes simulate the transmission and reception of voice calls and data packets, and take into account the effects of bit errors.

CONSTRUCTION:
Human Participation: For script preparation. Interruptable.

Time Processing: Dynamic; Event-step.

Treatment of Randomness: Deterministic; stochastic-calculations.

Sidedness: One-sided.

LIMITATIONS: Up to 40 backbone nodes, up to 200 extension nodes and radio access points, up to 15,000 subscribers.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Add Packet Radio Model, improved integration, new communications technologies.

INPUT: Network laydown, jammer laydown, equipment characteristics, call scripts, user mobility scripts, terrain data, subscriber affiliation, physical event (destruction, jamming) script.

OUTPUT: Raw data - disposition of each call in the call scripts. Analyzed data - statistical analysis of output data. Computer printouts; visual displays.

HARDWARE AND SOFTWARE:
- Computer (OS): 486 (UNIX/DOS) or DEC 3100/76 (VMS) with IRIS Workstations.
- Storage: 600 megabytes required.
- Peripherals: 1 printer required.
- Language: General Simulation System (GSS) from Prediction Systems, Inc., C., Windows, Clipper, and Quattro Pro.
- Documentation: Will be extensively documented with 7 manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Default data bases provided, changes allowed.

CPU time per Cycle: Hours, depends on the complexity of the laydown and scripts.

Data Output Analysis: Performed by the analysis module. Can be modified by user.

Frequency of Use: Could be several times per month depending on needs.

Users: JTC3A, U.S. Army, and various NATO countries.

Comments: Configuration control and updates managed by JTC3A in consultation with NATO PG/6.

TITLE: ABATAK - Air Base Attack Model.

DATE IMPLEMENTED: August 1983.

MODEL TYPE: Analysis.

PROPONENT: The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Edmund J. Bitinas, (703) 848-5246.

PURPOSE: ABATAK is a research and evaluation tool used to determine weapon system effectiveness, force capability, and requirements for air base attack effectiveness and sortie generation resource planning.

DESCRIPTION:
Domain: Single airbase.

Span: Multi-day sortie generation for single airbase.

Environment: Explicit time of day, geographic distribution of airbase facilities and interconnecting runways, taxiways, and roads.

Force Composition: Single airbase, with all forces and supporting infrastructure.

Scope of Conflict: Conventional, chemical, and nuclear weapons effects.

Mission Area: Aircraft sortie generation and offensive counter air.

Level of Detail of Processes and Entities: Explicit aircraft, logistics (by each or ton), ground crew personnel and airbase facilities (hangars, shelters, etc.).

CONSTRUCTION:
Human Participation: Not required. Model interruptable with scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic with random values generated from input functions.

Sidedness: One-sided.

LIMITATIONS: Damage repair times are input and do not consume resources.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Airbase geometry and facility layout; number of assets available; number of aircraft; sortie generation profile over time; attacks, including aim points and effectiveness; off-base attrition; and break rates of aircraft.

OUTPUT: Printed listing of sortie generation over time, resource utilization, and attack effects; graphics postprocessor for trends over time.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS family.
Storage:	1 MB.
Peripherals:	Printer and hardcopy graphics.
Language:	FORTRAN with DISSPLA graphics.
Documentation:	User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One to three months.

CPU time per Cycle: Seven days of sortie generation in 15 minutes.

Data Output Analysis: Postprocessor provides graphics as well as raw data output.

Frequency of Use: One to three studies per year.

Users: The BDM Corporation.

Comments: None.

TITLE: ABM - Armor Breakpoint Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis and training.

PROPONENT: Data Memory Systems, Inc., Historical Evaluation & Research Organization, 10392 Democracy Lane, Fairfax, VA 22030, (703) 591-3674; FAX (703) 591-6109.

POINT OF CONTACT: Maj. C.F. Hawkins, USAR (Ret).

PURPOSE: Used to realistically terminate force-on-force armored combat engagement simulations.

DESCRIPTION:

Domain: AirLand Battle.

Span: Individual engagement sector(s).

Environment: Desert, steppe, Central European hills and forests, any environment suitable for armor/mechanized operations. Best results in desert, poorest in wooded hills.

Force Composition: Armor/Mechanized.

Scope of Conflict: Conventional warfare.

Mission Area: Predicts forced changes of combat posture (breakpoints) for attacker or defender.

Level of Detail of Processes and Entities: Extremely simple. Three factors common to war games--spatial effectiveness, exchange of armor loses, and casualty percent per day ratio--are used to terminate armored combat simulations.

CONSTRUCTION:

Human Participation: None, if desired.

Time Processing: N/A.

Treatment of Randomness: Deterministic, based on empirical (historical) combat data.

Sidedness: Two-sided.

LIMITATIONS: Can be used only with armored/mechanized combat simulations. Works best in desert-like environments--94% to 100%; poorest in hilly, wooded areas--70% to 83%.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Adaptation of the model to show the conditions associated with successful attacker breakthrough operations.

INPUT: Distance advanced by attacker, width of front, armor losses for RED and BLUE sides, personnel casualty rates for both sides.

OUTPUT: The side that broke, or was forced to change posture--Event Version. The side that broke, and when -- Time-Step Version.

HARDWARE AND SOFTWARE: N/A. The Armor Breakpoint Model can be easily incorporated into any combat simulation that provides the referenced inputs. The ABM is provided with the research study documentation and supporting data analyses. Copyright protected.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: At the end of an engagement simulation (event version), or at time intervals (e.g., six hours) during an engagement simulation to determine if a breakpoint has occurred.

Users: Mitsubishi Space Software Co., Ltd.

Comments: The ABM derives its parameter values from 47 armored combat engagements between Arab and Israeli forces, with predictive results in the range of 94% to 100%. Validation tests against 113 other historical armored combat engagements in other wars and theaters gave predictive results that ranged from 70% to 100%, averaging 80%. The ABM is descriptive, not causal. Intuitively, however, the results make sense.

TITLE: ACAAM - Air Courses of Action Assessment Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource and Assessment Directorate (J-8/TSD), The Joint Staff, The Pentagon, Room 1D929, Washington, DC 20318-8000.

POINT OF CONTACT: CDR P. Morris, (703) 693-4605, AV 223-4605.

PURPOSE: ACAAM is an operations and planning support tool (decision aid) that is used to assess integrated strike plans for aircraft and cruise missile delivery of conventional weapons.

DESCRIPTION:
Domain: Air and sea.

Span: Local to regional.

Environment: Terrain relief includes cultural features (employs digital terrain and elevation data).

Force Composition: Aircraft, cruise missiles, surface-to-air missiles, and close-in weapon systems (WAS only).

Scope of Conflict: Conventional, power projection (land and sea).

Mission Area: Integrated cruise missile and aircraft strike planning.

Level of Detail of Processes and Entities: Processes: Target evaluation, weaponeering, allocation, route development, strike force coordination, strike prestrike assessment, airborne interception, and stand-off jamming. Entities: Aircraft, cruise missiles, surface-to-air missiles and close-in weapons systems (WAS only).

CONSTRUCTION:
Human Participation: Required for processes and decisions.

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Prestrike assessment is stochastic, Monte Carlo.

Sidedness: Two-sided, reactive only via system iterations.

LIMITATIONS: No on-board/standoff jamming (land attack only). Model executes on SUN 4 workstation. Limited aircraft representation (i.e., full representation of A-6, FA-18, F-111, KA-6D, KC-135; partial representation of A-7, B-52).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model will be available on the SUN computer for operational deployment third quarter FY92.

INPUT: Targets, defenses, resources, assets, digital terrain elevation data performance characteristics, and weapons system performance characteristics.

OUTPUT: Computer printouts, plots, raw data, terminal graphics, and hardcopy of graphics screens. Prioritized target list; single-shot probabilities of damage; weapon system to target allocations; strike routes including time distance, fuel, and probability of survival values; potential in-flight and fratricide conflicts; damage expectancy to the target base; and own force vulnerability estimates reports.

HARDWARE AND SOFTWARE:
Computer: SUN 4 workstation.
Storage: N/A.
Peripherals: CD ROM, Printer.
Language: ADA, FORTRAN, C, C++, AIEL, and INGRES.
Documentation: ACAAM User's Manual.

SECURITY CLASSIFICATION: Model without data is unclassified. Weaponeering algorithm will be secret.

GENERAL DATA:
Data Base: 8 hours.

CPU time per Cycle: 5 minutes.

Data Output Analysis: Immediate to 2 hours.

Frequency of Use: Depends on requirements.

Users: Joint Staff, J-8.

Comments: Model to be employed by CINCPAC in FY92 to support distributed contingency planning capability.

TITLE: ACCES - Army Command and Control Evaluation System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Evidence Based Research, Inc.

POINT OF CONTACT: Richard L. Layton, (703) 893-6800.

PURPOSE: ACCES is a force capability tool used to analyze the effectiveness of headquarters processes and procedures. A headquarters directing forces in a command post or field exercise is studied, and data are collected to compare the headquarters' actual performance with its expected decision making performance.

DESCRIPTION:
Domain: The entities and processes dealt with in the ACCES model operate primarily within the abstract realm of the decision making processes of the subject headquarters.

Span: Corps and division level.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: The lowest level entity modeled is the headquarters under evaluation. The lowest level of entity considered is the headquarters (brigade or division) subordinate to the subject of evaluation. The lowest level of process considered is the individual plan or decision element, while the standard unit of measurement is the individual plan or decision cycle.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: The model itself is static, in that it has no real time feedback provisions. The processes of the model, however, deal with the decision making cycle in both time-step and event-step terms.

Treatment of Randomness: The model is deterministic, in that its products are observations based on the comparison of actual performance with expected performance levels.

Sidedness: One-sided.

LIMITATIONS: The model does not include any combat simulation functions, and therefore requires a separate exercise, simulation, or wargame to generate the conditions for the headquarters operations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Currently being enhanced, to include greater detail in data collection and effectiveness measurement, automation of data collection and reduction, development of an automated analytical process to allow speculative analysis of hypothetical changes in training, procedures, equipment, and decision aids.

INPUT: Input data include data on exercise parameters (weather, scenario type, OPFOR, etc.), headquarters (T.O.& E., situation, training, etc.), communications (clarity, speed, accuracy, etc.), assessments and plans (correctness and completeness of assessments, initiative of plans, etc.), and directive (match to commander's intent, effectiveness, etc.).

OUTPUT: Output takes the form of statistical correlations and interpretation, geared to assessing the effectiveness of the subject headquarters processes and procedures.

HARDWARE AND SOFTWARE: The interpretation portion of the model does not require computer hardware, but a variety of hardware and software is employed in data reduction, data analysis, and statistical correlation. Employment of hardware for data collection is a possibility under study.

SECURITY CLASSIFICATION: The model itself is unclassified, although the input data are usually of a classified nature.

GENERAL DATA:

Data Base: Dependent on level of exercise and level of detail in data collection.

CPU time per Cycle: CPU time per application relates to statistical correlation, and depends on the magnitude of the data base.

Data Output Analysis: The results of data reduction and analysis are effectiveness scores and observations of command and control trends and insights, specific and general, arising therefrom, in briefing and report form.

Frequency of Use: Seven applications have been made, from December 1987 to June 1991, and more applications are planned for the summer and fall of 1991.

Users: United States Army.

Comments: Current enhancements are part of a multi-year contract with the U.S. Army Research Institute, Fort Leavenworth Field Unit.

TITLE: ACE - Advanced Campaign Effectiveness Model, Version II, and the Sortie Evaluation (SORVAL) Postprocessor.

DATE IMPLEMENTED: March 1987 (ACE-11), December 1987 (SORVAL).

MODEL TYPE: Analysis.

PROPONENT: Rockwell International, North American Aviation, Operations Analysis Department, 011-116/061--GB02, El Segundo, CA 90045.

POINT OF CONTACT: Michael S. Anderson, (213) 414-2294.

PURPOSE: ACE is used to establish the effectiveness of a strategic sortie penetration of an enemy air defense system.

DESCRIPTION: ACE simulates an offensive force of bombers, cruise missiles, and support aircraft penetrating a defensive structure of ground and air threats. Important output MOEs are bombers probability of survival and number of WOT. Bomber PS may be calculated on either a Monte Carlo or expected value basis. WOT is measurable for both fixed, planned targets and for SRT missions.

Domain: Air, SIOP operations.

Span: Global or theater.

Environment: Geographically based (latitude/longitude input). Extensive use of PK tables.

Force Composition: Combined and joint forces.

Scope of Conflict: Strategic nuclear and conventional forces.

Mission Area: SIOP.

Level of Detail of Processes and Entities: Entities: Aircraft (bomber, short-range missile, gravity weapon, cruise missile, fighter, and AWACS by tail number); EW/GCI (by site; i.e., collocated collection of radars); SAM (by site; i.e., to battery level); airbase (by site; i.e., collection of airstrips and recycle facilities); net (defined by AWACS, EW/GCI, and fighter assigned to it); and targets (fixed targets by position and SRT targets by area of uncertainty and search evaluation position). Processes: Bomber, cruise missile (flight, weapon release, SRT search, and weapon launch); SAM (autonomous target detection, tracking, and engagement); AWACS, EW/GCI (AWACS orbiting, target detection, tracking, and net-wide warning); net (fighter commitment, vectoring, and recovery); airbase (fighter basing, refueling, and rearming); and fighter (remote air patrol, target detection, flyout, arrival, and engagement).

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step simulation.

Treatment of Randomness: Monte Carlo treatment of SRT search and fighter vectoring. Either Monte Carlo or deterministic treatment of bomber PS and fixed-target WOT.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: The numbers of entities playable in the model is controlled by FORTRAN parameter statements. The source code is simply recompiled to play more penetrators or threats. Terrain is played statistically and is represented by roughness codes at each EW/GCI and SAM site to modify the line-of-sight detection radius. Site-specific terrain is not played. The "mid latitude" method of representing geographical movement of bombers and fighters restricts play to the northern hemisphere.

PLANNED IMPROVEMENTS AND MODIFICATIONS: More detailed representations of the SAM fire and intercept game and the fighter vectoring and combat endgames. Port to UNIX environment. Graphical user interface for a simulation progress display and input data verification. Addition of DMA terrain effects on target tracking.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer:	IBM 4341 (VM/CMS), IBM 3084 (MVS/TSO), VAX 11/780 (VMS), SUN Series 4 (UNIX).
Storage:	Four MB RAM.
Peripherals:	Printer.
Language:	ANSI FORTRAN 77 and isolated system-specific code for date and time calculations.
Documentation:	Rockwell/NAA TFD-87-1100, "ACE-11 Operations Guide"; 1 March 1987; Rockwell/NAA TFD-87-1610, "SORVAL Operations Guide", 1 December 1987.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 4 to 10 weeks.

CPU time per Cycle: 30 to 60 minutes per replication.

Data Output Analysis: Variable.

Frequency of Use: Better than monthly.

Users: Rockwell/NAA; ASD/ENSS.

Comments: ACE is maintained and its configuration is controlled by Rockwell/NAA for use at Rockwell and ASD/ENSS.

TITLE: ACEM - Air Combat Evaluation Model.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Hughes Aircraft Company, Missile Systems Group, 8433 Fallbrook Avenue, Canoga Park, CA 91304.

POINT OF CONTACT: S.T. Baba, (818) 702-3033; C.M. Lance, (818) 702-2279; B.A. Lawson, (818) 702-3990.

PURPOSE: ACEM is a versatile few-on-few air-to-air combat research and evaluation tool. Its primary purpose is to evaluate the effectiveness of air-to-air combat weapon systems against current and future threat scenarios. ACEM engagements can be replayed through a variety of visual postprocessors (both graphical and video) which provide further assistance to the user in determining the effectiveness of weapon systems and tactical implementations.

DESCRIPTION:

Domain: Air; limited ground operations.

Span: Accommodates any regional or local scale depending on capability of weapon systems.

Environment: Air-based; effects of weather modeled for IRST purposes.

Force Composition: Blue and Red force weapon elements (air threats, weapons, ECM, ESM, etc.).

Scope of Conflict: Guided missiles (passive, inertial, semi-active, active).

Mission Area: Interception, air superiority, close air support.

Level of Detail of Processes and Entities: Entities include guided missiles, individual aircraft, airborne sensors, and fire control systems. Processes include tactical directives issued to individual aircraft which are reactive in nature (i.e., the aircraft movements are dependent upon the action of the enemy); and attrition for aircraft, which is modeled through probability of kill, based upon Monte Carlo results.

CONSTRUCTION:

Human Participation: There is no human participation. Once the model is executed, interruption is not permitted.

Time Processing: ACEM is a dynamic, time-stepped, and continuous process model.

Treatment of Randomness: Missile dynamics are basically deterministic. Air attrition stochastically based on probability of kill with Monte Carlo determination of results.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Models up to 24 fully functional aircraft and 30 mobile jamming platforms. ACEM was primarily designed for air-to-air scenarios but will also model air-to-surface and surface-to-air scenarios. Any individual scenario is limited to 600 seconds of engagement time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model is continually being improved and enhanced. However, major improvements and modifications are currently in the planning stages for ACEM's IRST and radar modeling capabilities.

INPUT: Inputs to ACEM consist of detailed descriptions of each player in a given air combat scenario. For each player, this description includes aircraft type, avionics type, missile loadouts, initial geometry, and the tactical doctrine employed. Individual aircraft, avionics, and missile parameters may also be included in the input to model the effects of weapon system enhancements.

OUTPUT: ACEM output includes printouts of: 1) an event summary of the engagement; 2) various measures of effectiveness (e.g., probability of survival and red/blue exchange ratios); and 3) various statistical data (e.g., probability of kill confidence levels and aircraft survivability distributions for Monte Carlo runs). Engagement plots can also be generated via a line printer or pen plotter. Video output of an ACEM engagement is possible on a color-capable Macintosh computer system.

HARDWARE AND SOFTWARE:

Computer(OS): ACEM is designed to run on a VAX (8800, 8650, 3000) computer with a VMS operating system. A version has also been created which will run on the Macintosh personal computer.

Storage: 2 Megabytes: programs, inputs, data base, outputs.

Peripherals: Printer or plotter and terminal.

Language: ACEM consists of approximately 20K lines of FORTRAN code.

Documentation: ACEM User's Manual, August 1989.
ACEM Operator's Guide, July 1990.
ACEM Executive Overview, March 1991.

SECURITY CLASSIFICATION: The model, without data, is unclassified.

GENERAL DATA:

Data Base: Minor data modifications to existing weapon systems requires only a few hours to prepare the data base. To generate a completely new weapon system data base will require anywhere from a couple of days to a few weeks depending upon the complexity of the system. The scenario data base can be generated in less than a day.

CPU time per Cycle: A simple one-on-one engagement can be completed in less than 30 seconds of CPU time. Extensive Monte Carlo scenarios, using all 24 aircraft, will require over six hours of CPU time to complete.

Data Output Analysis: Postprocessor aids in analysis of output. Computer animated or graphical plot available for analysis. Printouts provide hardcopies of raw data and statistics.

Frequency of Use: Daily.

Users: Hughes Aircraft Company.

Comments: Although ACEM was primarily designed to be a missile effectiveness tool, the model is constantly upgraded to reflect enhancements made to other systems as well; hence, it is always being improved to show the overall effectiveness of the weapons system as a whole.

TITLE: Aces STRATWAR.

DATE IMPLEMENTED: March 1990.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: STRATWAR is a nuclear planning and employment exercise. The STRATWAR computer model is a seminar exercise driver designed to reinforce the concepts of nuclear command and control, the nuclear planning decision, nuclear command and control, and nuclear weapons employment. It involves arms reduction, basing and deployment of weapons systems, intelligence collection, building a strategic integrated operations plan (SIOP), and executing the SIOP. STRATWAR is also part of the Air Force Command Exercise System (ACES), the successor to the Command Readiness Exercise System. ACES is designed around a single wargame engine concept whereby different wargames use the same combat simulation interacting through tailored player interfaces. STRATWAR is the first wargame developed under ACES. Additional wargames are under development, with a theater wargame leading the way.

DESCRIPTION: STRATWAR is an automated, two-sided, nuclear planning and employment exercise. It concentrates on arms reduction negotiations, force deployment, targeting, and force execution.

Domain: Air and naval (submarine) operations.

Span: Global, with combatants being the U.S. and USSR.

Environment: STRATWAR's strategic force execution phase is real-time and interactive. It includes round-the-clock operations as well as time and distance factors. The world view is hex based.

Force Composition: Strategic and tactical air and naval forces. Joint and combined forces are modeled.

Scope of Conflict: Global Thermonuclear War.

Mission Area: Nuclear strike missions from intercontinental ballistic missiles, intercontinental bombers, tactical bombers, ballistic missile submarines, and SLCM-carrying attack submarines. Defensive operations from fighter aircraft and antiballistic missile defenses. Antisubmarine naval operations from attack submarines and antisubmarine warfare aircraft. The wargame includes force posturing, dispersal, and recall. The wargame stresses combining weapons and procedures to achieve the objectives of strategic aerospace offense and defense, counter air, air interdiction, aerospace maritime operations, and antisubmarine warfare and intelligence.

Level of Detail of Processes and Entities: The smallest entities modeled are individual aerospace platforms (aircraft and missiles), ground targets (military units, bases, cities, petroleum refineries, etc.), and individual submarines. These entities are affected by attrition, communications, movement, targeting, terrain, and weather.

CONSTRUCTION:

Human Participation: Required for both decisions and processes.

Time Processing: During the force execution phase, the wargame model is real time, interactive, and basically event driven; however, internal situation status checks are also made at specific time intervals.

Treatment of Randomness: Monte Carlo determination on the probability of event occurrence with deterministic table look ups for combat attrition.

Sidedness: Symmetric two-sided, with Blue and Red teams.

LIMITATIONS: Ground forces are not played. The SIOP execution is not modeled in great detail because its objectives do not require it. For example, terrain features are generic for all hexes. Entities within hexes are placed at the center, somewhat restricting ground movement, collateral damage, and targeting. Many detailed mission attributes such as electronic jamming are available but not played.

PLANNED IMPROVEMENTS AND MODIFICATIONS: STRATWAR is enhanced through inputs from sponsors via a configuration management process. Currently, a scenario management system is under development to ease game startup and data entry.

INPUT: STRATWAR is structured in four phases. Red and Blue first interactively negotiate nuclear arms reduction. Players assign points to their strategic weapons systems and reduce the opposing players' systems. Each side then bases, deploys their remaining forces, and requests intelligence on a subset of their opponent's bases. Then each side builds a SIOP by prioritizing targets and assigning weapons systems to options. During the execution phase, players are given the opportunity to employ their nuclear forces under wartime threat conditions. Employment consists of executing SIOP options, posturing, dispersal, and recall.

OUTPUT: Arms negotiations reports, force deployment reports, intelligence reports, targeting reports, sortie status reports, and target status reports. An off-line program called the Automatic Targeter performs SIOP warhead-to-target assignment based on player targeting input. This SIOP is also available as a report. Map graphics are used extensively in the execution phase.

HARDWARE AND SOFTWARE:

Computer (OS): Sun 386i network running SUN OS 4.0.2 or higher with 16 megabytes of random access memory and 320 megabytes disk-drive per machine. STRATWAR uses two Control Data Corporation Cyber mainframes each running NOS/VE--1 has 64 megabytes and the other 128 megabytes random access memory. Each CYBER has 9.4 gigabyte disk storage. A TCP/IP Ethernet network running NFS is also used.

Storage: Requires 30 megabytes for software (source and executable) resident on the Sun 386i (not including COTS software). To run the standard 11 simultaneous wargames, 2 gigabytes are required for the Cybers. To run a single wargame requires 50 megabytes.

Peripherals: Uses 14-inch color monitors with 1152 x 900 pixel resolution and laser printers for Suns. Each Cyber has a Control Data 587-1 Band Printer. STRATWAR also uses 8088-based IBM-compatible microcomputers.

Language: C (using X11 Motif and Athena libraries), ORACLE relational data base management system (including SQL*Forms, SQL*ReportWriter, SQL*Plus, Pro*C), UNIX shell scripts, CDC Fortran, MIDAS preprocessor (limited availability).

Documentation: Functional Description, System Specification, Software Unit Specifications, Maintenance Manuals, Operations Manual, Data Base Manual, and Player Game Books.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: About 1 man-month to rebuild data base and 4 man-months to create a new data base.

CPU time per Cycle: Not applicable.

Data Output Analysis: Hardcopy via line printer and on-screen graphic displays. Includes controller output report for determining if Strategic Reserve Force levels are sufficient.

Frequency of Use: Once per year.

Users: Air Command and Staff College.

Comments: Managed through review and configuration control board at the AFWC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: Ada SAM - Surface-to-Air Missile.

DATE IMPLEMENTED: 1987.

MODEL TYPE Analysis.

PROPONENT: ASD/RWA.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The Ada SAM model demonstrates that the modular approach to Ada Radar design allows for generic radar modeling which can become the foundation for a detailed, flexible, and expandable radar model.

DESCRIPTION: The missile model is divided into five representative major objects. These are the target, the TELR, the missile, the geometry routine, and the controller routine. Each object has a unique function and interfaces with the other objects in a predetermined, logical fashion.

Simple object functions are described by a single, cohesive algorithm generally consisting of fewer than fifty lines of code. The target, geometry, and controller processes are such examples. In this simulation, a simple objective was converted into an Ada process called a task.

Some object functional descriptions are too complex to fit into one algorithm. In these cases, the objects are divided into sub-objects that are more narrow in scope and function. This process is continued until each object is represented by a simple process or task.

INPUT: There are five input files in this simulation. The files have logical program names of: 1) Firing_Doctrine_Data, 2) Flag_Data, 3) Start_and_Stop_Data, 4) Target_Data, and 5) TELR_Trajectory_Data.

OUTPUT: Only one output file is created to record all the time history information for the simulation. It is called OUTPUT_DATA.

OUTPUT DATA: After a run of ARCH (the name of this program), a file called OUTPUT_DATA appears in the user's workspace. Each run writes over this file, so it is wise to rename OUTPUT_DATA upon program termination. The file consists of frames of data which are filled at time intervals set by the user in START_AND_STOP_DATA. The current state of all selected variables is output to the file, along with the current simulation time. The frames are separated by a string of asterisks. At the end of the run, the miss distance, the termination time, and an appropriate message are output.

HARDWARE AND SOFTWARE:

Computer:	VAX, 7.2 Mbytes.
Storage:	7.2 Mbytes.
Language:	Ada.
Documentation:	Ada Radar Model, Hybrid Computer Monopulse Techniques, Evaluation Final Report.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:

Time Requirements: Compilation time: 45 minutes to 1 hour; Typical run time: depends on step size used, usually is 1 minute/step of simulation.

Users:

Battelle Memorial Institute - Columbus Div.
General Research Corp.
Harris - GISD Software Operations
MSD/ENYS
McDonnell Aircraft Company
SAIC
Sverdrup Technology, Inc. - TSG

TITLE: ADB - Aircraft Data Base.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Operations Analysis (OA) Unit, Boeing Military Airplanes (BMA), Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: John E. Huffman, (316) 685-9669.

PURPOSE: ADB is used as a data manager for many of the mission simulation models used at Boeing OA. In particular, ADB supplies data organized in the Relation Information Management data base to Tanker/Airlift models. Data is taken from eight different data base relations.

DESCRIPTION:
Domain: Model specific.

Span: Model specific.

Environment: Model specific.

Force Composition: Model specific.

Scope of Conflict: Model specific.

Mission Area: Model specific.

Level of Detail of Processes and Entities. Entity: Aircraft. Processes: Model specific.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Model specific.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Replacement of the Relational Information Management RIM system with the ORACLE Relational Data Base Management System.

INPUT: Data for the following relations: Climb, Descend, Takeoff, Constant Air Cruise, Maximum Range Cruise Condition, Maximum Range Endurance, Drag, Aircraft Parameters.

OUTPUT: Data, plots of data, printouts.

HARDWARE AND SOFTWARE:
Computer: APOLLO DOMAIN.
Storage: 400,000 blocks.
Peripherals: Printers, graphics plotters, and digitizers.
Language: DOMAIN FORTRAN 77, UNIX, and RIM.
Documentation: Boeing published manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Aircraft/Relations specific. Usually one man-week per aircraft.

CPU time per Cycle: Model specific. Can take hours of CPU time, but most sessions are quick.

Data Output Analysis: Used only to manage data.

Frequency of Use: Extensive access by simulation models.

Users: Tanker/Airlift group, BMU OA.

Comments: ADB is a data base and its supporting data management programs. The programs allow data plotting, query, review, appending, modification, access by external models, and management.

TITLE: ADB - Attrition Data Base for USAF Munitions Planning.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: AD/ENYS, Eglin AFB, FL 32542-5000.

POINT OF CONTACT: Mr. David E. Jeffcoat, (904) 882-9417, AV 872-9417.

PURPOSE: The ADB is used to select the "best" munition to perform a certain function. Data can also be used to evaluate the relative survivability of one weapon delivery profile to another or to do parametric studies to assess effects of changing variables in certain aspects of the attack. Other uses are to determine the best use of tactical aircraft by maximizing targets killed and minimizing aircraft losses.

DESCRIPTION:
Domain: Air.

Span: Theater.

Environment: Theater attack: day, night, and weather; first day, first wave only; mobile and fixed targets.

Force Composition: Enemy: SAM, AI, and AAA. Friendly: all tactical aircraft.

Scope of Conflict: Conventional.

Mission Area: Recognized combinations of weapons and procedures used to accomplish a specific objective. Close air support and battlefield air interdiction.

Level of Detail of Processes and Entities: BLUE: Single aircraft to flights of 24. RED: Total antiair threat laydown including SAM, AAA, AI, and EW.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, combination event-step and time-step model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, nonreactive.

LIMITATIONS: Nonsensitive to low-observable aircraft technology; no terrain following capability for aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporate low-observable methodology, automate input data updates, and add terrain following capability for aircraft.

INPUT: Aircraft vulnerability and performance characteristics, pilot reaction, digitized weapon delivery profiles, army deployment doctrine, and ADU performance characteristics.

OUTPUT: Paper output of raw attrition data by threat type, histograms of aircraft losses per replication, and attrition for specific attacks in available scenarios and time frames.

HARDWARE AND SOFTWARE:

Computer:	CYBER series with large core memory and NOS/BE operating system. VAX/VMS.
Storage:	28,000 blocks (14,336 megabytes).
Peripherals:	Remote terminal and printer.
Language:	FORTRAN V.
Documentation:	None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 8 months to prepare.

CPU time per Cycle: Usually 1 hour CPU time per job.

Data Output Analysis: Postprocessor produces tabular data for analyses of raw data.

Frequency of Use: Varied by demand, usually 10 to 12 times per year.

Users: HQ USAF and other AF agencies.

Comments: Managed through annual conference of users. Updates and changes approved by committee. Data retrieval program presents tabular attrition data for attacks in available scenarios/time frames.

TITLE: ADMRALS - Attack and Defense of Maritime Resources in Adverse Locales.

DATE IMPLEMENTED: 1987.

PROPONENT: Space and Surface Systems Division (K10), Naval Surface Warfare Center.

POINT OF CONTACT: Dr. Jeffrey N. Blanton, (703) 663-8209; AV 249-8209.

PURPOSE: ADMRALS has been developed to serve as a Naval battle force level systems analysis tool to conduct weapon system/ platform effectiveness evaluations and to assess force architecture options. It is primarily a distributed simulation environment where new and in some cases existing component models can be integrated to provide multiplatform/multiwarfare capabilities.

DESCRIPTION:

Domain: Sea, air, space, limited undersea.

Span: Regional.

Environment: Weather, seastate, limited EW effects.

Force Composition: Blue surface, subsurface, air and space platforms. Red Air and limited surface and subsurface platforms.

Scope of Conflict: Conventional and unconventional existing and postulated Red air to air and air to surface weapons. Conventional and unconventional existing and postulated Blue air to air and surface to air. Some EW.

Mission Area: Fleet defense.

Level of Detail of Processes and Entities: Dependent on models integrated. Currently system level (sensors, weapons, performance, decisions, etc.) on Blue platforms. AAWC and airborne early warning aircraft control multiple Blue fighter models in outer air battle. Fleet point and area defense modeled parametrically at platform level.

CONSTRUCTION:

Human participation: Not required (soon to be added as option). Humans modeled as rule bases or neural networks. System is interruptable.

Time Processing: Dynamic time-step.

Treatment of Randomness: Basically deterministic with random number draws for probability of kill, etc. Can be run Monte Carlo. Some stochastic models (direct computation) have been included for some scenarios.

Sidedness: Two-sided, asymmetric, Blue reactive.

LIMITATIONS: Function of integrated models. Currently limited to outer air battle and fleet point and area defense. Space based assets can be included as option, limited antisubmarine warfare modeling at present.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved simulation architecture to facilitate model integration and enhance capabilities. Modifications to allow operation as variable time-step or event driven. Modifications to add neutral or unknown forces and to support reactive or nonreactive Red forces. Integration of addition platform models and other warfare areas.

INPUT: Red air platform definition, loadouts, flight profiles and targeting. Blue order of battle including surface platform definition, locations, loadouts and initial defensive air platform definition, loadouts, etc. Blue surveillance satellite constellation and sensor definition. Blue tactical rule bases.

OUTPUT: All data can be saved in a large relational data base post run analyses. Normally, predefined reports are generated that include user specified measures of effectiveness. Large screen graphics show animated time histories of engagements.

HARDWARE AND SOFTWARE:

Computer:	System designed to operate on a non-homogeneous distributed processing system. Processor restrictions include only UNIX operating systems and TCP/IP inter-networking protocol. Network configuration is application dependent, but three carrier battle groups defending against large Red air attack typically executed on 6 SUN 3/80 and SUN 4 workstations.
Storage:	41 MB.
Peripherals:	None required, however IRIS Silicon Graphics workstation used for graphics.
Languages:	Models in FORTRAN, PASCAL, and C. Network communication control system written in C.
Documentation:	NSWC Technical Reports on System Description, and Network Communication Control.

SECURITY CLASSIFICATION: Models unclassified, data bases often classified.

GENERAL DATA:

Data Base: One man-week for initial scenario generation.

CPU time per Cycle: Dependent on network configuration and scenario.

Data Output Analysis: Graphics and postprocessed reports are generated. Raw data is available.

Frequency of Use: Current average use is 3 to 5 times per month.

Users: Various NSWC Divisions.

Comments: ADMRALS is a distributed processing environment that is designed to integrate models into a force level multiwarfare simulation system. Its development is still evolving.

TITLE: ADS - Ammunition Distribution System.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Armament, Munitions and Chemical Command, ATTN: AMSMC-DSP-L, Rock Island, IL 61299-6000.

POINT OF CONTACT: Mr. N. Hoesly, DSN 793-5980/5891 or Mrs. Sharon Myers, DSN 793-4162.

PURPOSE: ADS is used to assess the logistics capabilities of the movement of class V ammunition from the wholesale CONUS base. Various readiness analysis and logistics shortfalls can be determined in the transportation system.

DESCRIPTION:

Domain: Depots, CONUS Ports, OCONUS Ports and ammunition supply points.

Span: Accommodates special studies to include Operational Plans and Total Logistics Readiness/Sustainability and other Single Manager for Conventional Ammunition (SMCA) ammunition distribution studies.

Environment: Accommodates any ammunition requirement.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Ammunition managed by the SMCA.

Level of Detail of Processes and Entities: ADS simulates the distribution of ammunition from CONUS depots and production plants to the overseas theaters during mobilization. Many processes are interfaced, including requisitioning, production, storage, CONUS shipping by truck and rail, transocean shipping by air and sea, and in-theater movement to the forward ammunition supply points.

CONSTRUCTION:

Human Participation: Closed loop; human participation required to build data bases.

Time Processing: Dynamic, closed form.

Treatment of Randomness: None. Heuristic rule based.

Sidedness: One-sided.

LIMITATIONS: Does not model complete in-theater distribution and utilize unconstrained transportation conveyances.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Unknown.

INPUT: Data Elements: Ammunition requirements, ammunition assets; Ammunition Item Information; Transportation Network, Data Sources: Systems Integration Management Activity (SIMA); MTMC Data Bases: CCSS data base; AMSAMOB data base.

OUTPUT: Ammunition distribution plan; various reports depicting ammunition movements from depots, thru ports (CONUS and OCONUS), and to the ammunition supply points. Other reports depicting readiness postures against an ammunition requirement.

HARDWARE AND SOFTWARE:

Computer:	PRIME 9955 Mod 2.
Storage:	Unknown.
Peripherals:	PRIME computer systems.
Language:	FORTRAN IV, F77, CPL.
Documentation:	ADS Executive Manual, ADS User Manual, ADS File Formats.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Takes several weeks.

CPU time per Cycle: Unknown.

Data Output Analysis: Reports aid in analysis of distribution plan. Produces hardcopies and computer files of raw data.

Frequency of Use: Varies by command, but is used several times per year to support the users listed below.

Users: Joint Chiefs of Staff, (JCX/J4), Logistics Evaluation Agency, and Industrial Engineering Activity.

Comments: This model is very complex and consists of many programs that are scheduled and processed to accommodate each study or analysis.

TITLE: ADSS - Air Defense Simulation System.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: USAADASCH, Directorate of Combat Development, Ft. Bliss, TX.

POINT OF CONTACT: Combat Modeling Branch, DCD: Mr. John Armendariz, (915) 568-1238; COLSA, Inc., EL Paso, TX,
24
Ms. Mary Anne Larson, (915) 779-5899.

PURPOSE: ADSS is used primarily for analyses of air defense systems and subsystems, tactics, and doctrine. It is a useful tool for Mission Area and Branch Analyses.

DESCRIPTION:

Domain: Land and air.

Span: Designed primarily for "few-on-few" scenarios but can be used for one-on-one to corps scenarios. Can accommodate any theater for which Defense Mapping Agency terrain data is available.

Environment: DMA DTED Level 1 terrain data is used. Terrain foliage and urban area heights, visibility and ambient light conditions and time of day are user inputs.

Force Composition: Component, Blue and Red.

Scope of Conflict: Conventional weapons and their effects; chemical effects including casualties and degradation.

Mission Area: Primarily used for air defense battles lasting two hours or less.

Level of Detail of Processes and Entities: Entities may be modeled at the level of individual vehicles, aircraft, sensors, weapons, and rounds of ordnance up to an aggregation equivalent to a company or battery. Both ground-to-air and air-to-ground combat are modeled. Aircraft, ground units, and defended assets may all move according to user input scripts. Functions such as sensor acquisition, detection, tracking, engagement, launch and missile flyout are modeled at high resolution. When completed this year, the model will also simulate the end game intercept geometry for tactical missile engagement.

CONSTRUCTION:

Human Participation: Required for data input.

Time Processing: Dynamic, event-stepped model.

Treatment of Randomness: Stochastic, discrete event model.

Sidedness: Two-sided, symmetric model.

LIMITATIONS: Ground-to-ground and air-to-air combat is not modeled. This, however, can be implemented with minor changes.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Functions to be added include: jamming; noncooperative ID devices, reactive masking/unmasking by helicopters, anti-radiation missiles with target reselection; chemical warfare module

INPUT: No data are hardwired; sensor/weapon characteristics, lethality tables, communication networks, etc., are user input. Scenario dependent inputs may be created on the graphics preprocessor or input directly to the model.

OUTPUT: Printout of report (major statistics) and event history (detailed tracking of each unit) produced. A file is output to be used by the statistical postprocessor to analyze multiple measures of effectiveness and measures of performance.

HARDWARE AND SOFTWARE:

Computer:	VAX series - VMS operating system. Silicon Graphics IRIS Workstation - UNIX operating system (Preprocessor).
Storage:	16 MB of RAM and 100 MB of disk storage are needed for efficient execution. Most of the disk storage is required for the terrain data base.
Peripherals:	Printer. If graphics preprocessor is used, it must be networked to the VAX.
Language:	SIMSCRIPT 11.5.
Documentation:	Executive Summary, ADSS User's Manual, Preprocessor Manual, Postprocessor Manual.

SECURITY CLASSIFICATION: Model is unclassified. Input data may be unclassified or classified to the Secret level. Output is kept unclassified by use of data keys

GENERAL DATA:

Data Base: From several days to two months depending on scenario size.

CPU time per Cycle: Scenario and machine dependent. An average brigade scenario flying 37 aircraft runs 60 - 90 minutes per replication on a MicroVAX 3600 with 32 MB RAM. Smaller scenarios at company/battery level run in less than five minutes.

Data Output Analysis: Postprocessor used for statistical analysis of each replication and over multiple replications.

Frequency of Use: Several times per year.

Users: USAADASCH.

Comments: Upgraded both upon government request and funding (task order), and by COLSA, Inc., independent research and development activities.

TITLE: ADTAM - Air Superior/Air Defense Tanker Analysis Model.

DATE IMPLEMENTED: This model is presently being developed.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis, Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: John A. December, Boeing Military Airplanes, Operations Analysis, (316) 526-2956.

PURPOSE: The purpose of the ADTAM is to determine the tanker requirements for the refueling support of a continuous barrier patrol operation with intermittent forward excursions to engage and defeat intruders beyond the barrier.

DESCRIPTION:

Domain: Land and air.

Span: Global.

Environment: Distances.

Force Composition: Fighter force.

Scope of Conflict: Conventional.

Mission Area: Air Superiority/Air Defense.

Level of Detail of Processes and Entities: Entities: Individual aircraft. Processes: Single air refueling.

CONSTRUCTION:

Human Participation: Required to set up data files for execution.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model aircraft loading, loading times, aborted air refuelings, or replacement aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Completion of model.

INPUT: Input fields are required to provide the following information: force specification (fighter types, fuel-burn data, aircraft parameters, time on station requirements); and allocation option (type of tankers to potentially use, and costs).

OUTPUT: Output includes summary information on the number and types of aircraft used, fuel burn, and onload amounts; and detailed information on the times, distances, and fuel amounts for each orbit location.

HARDWARE AND SOFTWARE:

Computer: Developed to run in a network of APOLLO DN3000 and DN660 terminals running a AEGIS-DOMAIN/IX (Unix-based) operating system, software release 9.5.

Storage: Currently about 200K for the executable model. Data bases require additional space.

Peripherals: 1 printer, 1 terminal.
Language: APOLLO/DOMAIN Pascal and FORTRAN APOLLO DOMAIN/IX operating system calls, and RTIRIM data base management system that makes calls to Boeing Military Airplanes' Aircraft Data Base.
Documentation: Documentation of analysis using the portion of the model that computes data for unrefueled aircraft is available.

SECURITY CLASSIFICATION: Unclassified, but data could be classified.

GENERAL DATA:
Data Base: Aircraft data base is established for many aircraft.

CPU time per Cycle: Model incomplete.

Data Output Analysis: Output reports include summary output and detailed output in chart form.

Frequency of Use: Used once for an analysis involving unrefueled aircraft.

Users: Boeing Military Airplanes, Operations Analysis, Tanker/Airlift Program Support.

Comments: N/A.

TITLE: AEM/FROBAK - Arsenal Exchange Model/Front End-Back End Processor.

DATE IMPLEMENTED: 1965 (updated 1974).

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAS). Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Mr. Patrick Wheeler (703) 697-9483.

PURPOSE: AEM is based on the linear programming algorithm for evaluation of a one- or two-sided nuclear exchange. AEM uses a force structure(s) combined with its related strategic planning factors and allocates weapons against an opponent's target base. Each side has a set of rules for the deployment of their weapons; e.g., ICBMs against silos, SLBMs against factories, etc.

FROBAK is used to reduce the size of the target base (aggregation of target classes) to a number compatible with AEM's linear programming algorithm. FROBAK can also "unaggregate" damage estimates back to the original installations as well as describe compound damage between installations in close proximity of each other.

The main focus of AEM is to evaluate alternative force structures for future budgets or arms control agreements.

DESCRIPTION:

Domain: The model represents the nuclear arsenals of two opposing countries and the damage they can inflict. The physical environment is not modeled as such; only parameters such as probability to penetrate, CEP, and target hardness are used within AEM.

Span: Global based upon the restrictions listed in the domain section above.

Environment: The environment other than target size and hardness is not considered.

Force Composition: Any or all legs of the nuclear triad.

Scope of Conflict: Nuclear.

Mission Area: Nuclear.

Level of Detail of Processes and Entities: The lowest entity modeled is at the system level. Processes are modeled very crudely via a probability. Processes include (but not limited to) attrition, communications, and prelaunch survivability.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Closed form. Some implicit consideration is given to arrival times such as immediate (ICBMs), short delays (SLBMs), or long delays (aircraft).

Treatment of Randomness: Expected value method.

Sidedness: One- or two-sided (usually one-sided) and asymmetric with one side initiating the exchange.

LIMITATIONS: AEM is forced to use very simplistic descriptions of weapons to keep running time reasonable (around 20 minutes per run). Conversely, there is great flexibility in allocating weapons against targets; however, running time is always a major consideration in any set of runs.

PLANNED IMPROVEMENTS AND MODIFICATIONS: These are done on a very pragmatic basis motivated by a user's immediate needs.

INPUT: Requires weapons system force levels and planning factors, target base, and general rules for deployment of weapons.

OUTPUT: Expected damage, target coverage, arriving weapons, and virtually any other strategic MOE can be generated.

HARDWARE AND SOFTWARE:

Computer:	Any computer that can handle a large program written in Fortran 77. AFSAA uses a SUN workstation to run both AEM and FROBAK.
Storage:	Minimum practical system would require 100 megabytes.
Peripherals:	1 workstation with printer.
Language:	Fortran 77.
Documentation:	Extensive.

SECURITY CLASSIFICATION: Model unclassified.

GENERAL DATA:

Data Base: Depends on level of detail.

CPU time per Cycle: Depends on level of detail.

Data Output Analysis: Depends on level of detail.

Frequency of Use: Daily.

Users: AFSAA, JCS/J-8, HQ SAC/XP, over 40 users.

Comments: Links to Advanced Missile Model, Strategic Route and Penetration Model, RSIOP analysis.

TITLE: AESOPS - AMSAA (Army Materiel Systems Analysis Activity) Evade Sustained Operations Performance Simulation.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Materiel Systems Analysis Activity (USAMSAA), Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: Mr. Dinsmore (301) 278-4973, AV 298-4973.

PURPOSE: AESOPS is a computerized, analytical, sustained operations model that simulates the operation of a helicopter unit over a period of several days of combat. It also introduces the impact of reliability, availability, maintainability, and combat damage repair of a helicopter type on unit availability during such operations. In addition, AESOPS can be used to analyze how various factors influence the dynamic operational readiness of the helicopters in sustained combat.

DESCRIPTION:
Domain: Air.

Span: Individual.

Environment: Unknown.

Force Composition: Units the size of a helicopter company.

Scope of Conflict: Conventional.

Mission Area: Close air support.

Level of Detail of Processes and Entities: Handles only one type of helicopter at a time. Solution techniques include probability theory and queuing theory.

CONSTRUCTION:
Human Participation: Not required, model not interruptable.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic, expected-value model.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: AESOPS is an expected-value model that can handle only one type of helicopter at a time. It does not generate its own damage state probabilities, and it obtains its inputs from EVADE II.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Number of helicopters required for mission; time from receipt of mission request to take-off, time to fly to target, time between target attacks, and time between mission requests; reliabilities for various helicopter damage states (obtained from EVADE II); repair times for each degree of helicopter combat damage and routine maintenance; and number of targets defeated in the mission.

OUTPUT: Computer printout showing number of helicopters lost; targets defeated; number of missions accepted over the time period of interest; and number of helicopters under repair, awaiting repair, in flight, or operationally ready (in tabular or plot form). Attrition for any time interval of simulation is an optional feature.

HARDWARE AND SOFTWARE:
- Computer: CYBER 173 (NOS 2.1).
- Storage: 32K.
- Peripherals: CALCOMP plotter.
- Language: FORTRAN IV.
- Documentation: Not complete.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1.5 man-months for preparation.

CPU time per Cycle: 40 seconds (per 8 days of combat).

Data Output Analysis: 0.5 man-month.

Frequency of Use: 15 times per year.

Users: USAMSAA and Ketron, Inc.

Comments: N/A.

TITLE: AFP - Analysis of Force Potential.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: George Stoll, (DSN) 295-5259 or (301) 295-5259.

PURPOSE: Quantify firepower potential of land combat forces of division size and larger for use in analysis of force levels and force ratios. Has been used primarily to analyze changes in total Army force potential attributable to force modernization. Has most recently been applied to analyze changes in force potential and force ratios associated with various proposed reductions in weapon procurement and U.S. and Soviet force size.

DESCRIPTION:

Domain: Land combat, limited close air support.

Span: Division level combat.

Environment: Models day and night combat and clear and degraded visibility in the full range of combat postures desired for a study.

Force Composition: Army.

Scope of Conflict: Conventional.

Mission Area: Direct fire battle, close air support, indirect artillery.

Level of Detail of Processes and Entities: Models individual weapons in weapon-on-weapon engagements through processes of detection, direct fire, indirect artillery, and attrition.

CONSTRUCTION:

Human Participation: Not permitted, model not interruptable.

Time Processing: Static.

Treatment of Randomness : Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: No representation of terrain or logistical support effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Major program underway to separate stochastic elements from deterministic elements. Stochastic element will be run in batch process and put into library; deterministic element will draw from library. Deterministic element will be implemented on microcomputer; stochastic element likely to remain on mainframe.

INPUT: Unit weapon composition, probability of kill tables, sensor characteristics, and scheme of weapon versus weapon engagement pairings.

OUTPUT: Attrition tables, combat potential values by weapon, and force combat potential scores.

HARDWARE AND SOFTWARE:

Computer: Currently UNISYS 1100 mainframe, future IBM compatible microcomputer.

Storage: Currently 240,000 words.

Peripherals: Tape drive, line printer.
Language: FORTRAN 77
Documentation: Operator's and Programmer's Guide to the Analysis of Force Potential System (AFPSYS).

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:
Data Base: 1 month.

CPU time per cycle: 15 minutes.

Data Output Analysis: 1 week.

Frequency of Use: 5-6 times per year.

Users: U.S. Army Concepts Analysis Agency.

Releasability: Releasable.

TITLE: Agile.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532. DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: Agile, a seminar exercise driver, exposes players to the high-level decision making process required to plan and execute a theater air campaign.

DESCRIPTION: Agile, a two-sided theater wargame, simulates a land and air battle of Europe's central region (1987) and North and South Korea (1990).

Domain: Land and air operations (includes carrier air operations) only.

Span: Central Europe and Korea.

Environment: Agile models day and night operations. It also includes terrain and weather factors.

Force Composition: Combined force campaign where Blue forces have operational control of air assets and complete control (limited only by the game's command set) of all ground units.

Scope of Conflict: Conventional war only. Agile schedules, but does not play nuclear weapon assets.

Mission Area: All conventional missions (no chemical or biological weapons).

Level of Detail of Processes and Entities: Agile extends control down to aircraft sorties. It does not permit play by tail number. Ground units maneuver at the division level.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Static and event-stepped. Progress determined by completion of both Red and Blue force play inputs.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, asymmetrical. Red side normally played by a single player but can be played by a seminar.

LIMITATIONS: No naval play except limited naval air.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Automated Red player and enhanced graphics.

INPUT: The Blue team has two phases. In the first or AAFCE level, players form their apportionment and overall plan for the game. Inputs include aircraft rerole, air and surface logistic movement, and aircraft beddown. The second phase moves to the ATAF level. Players input targeting and force package information. The Korean scenario corresponds to the European version with the names changed from ATAF to HTACC and from AAFCE to ACC. In addition, there is only one ACC.

OUTPUT: Agile automatically generates printed reports at the end of each game day. There are over 200 pages reporting on virtually every aspect of game play. Agile provides reports in three primary areas: operations, intelligence, and logistics. Limited analysis is available to help players analyze their overall plan for the game.

HARDWARE AND SOFTWARE:

Computer (OS):	IBM-compatible MS-DOS machine with floppy- and hard-disk drive storage, 640 kilobytes random access memory and the 8087 math co-processor. Agile also requires a printer and monitor.
Storage:	Requires 10 megabytes for the Red executable, 7 megabytes for the 2 ATAF Blue executable, and 5 megabytes for the 4 ATAF Blue executable.
Peripherals:	Minimum -- monochrome monitor (CGA recommended) and printer.
Language:	Lahey FORTRAN, PLink 86+ Linker.
Documentation:	User and Maintenance Manuals and Student Guide.

SECURITY CLASSIFICATION: All scenarios are unclassified.

GENERAL DATA:

Data Base: 70 files in 1.5 megabytes of storage. About 3 man-months to replace data base. Executables include 138 files requiring 5.3 megabytes of storage. In addition, there are screen and backup files. About 2 man-years are required to replace these.

CPU time per Cycle: Not applicable.

Data Output Analysis: Agile includes a monitor program to recover errors by both system and user.

Frequency of Use: Used at least once a year by each user.

Users: Air War College, Air Command and Staff, Canadian Forces Staff College, Combat Employment Institute, and Royal Air Force Staff College.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: AIM - A.S.A.T. Intercept Model.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze affectivity of stand off jammer decoys as ECM technique against satellites employing proportional nav.

DESCRIPTION: CSMP model of radar receiver servo loops and target geometry. FORTRAN coded ECM subroutine reads ECM parameters from CSMP model components.

INPUT: Basic ECM parameters.

OUTPUT: Azimuth and elevation tracking error data.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780-782.
- Storage: 50K Bytes; memory requirements: 1M Bytes.
- Language: FORTRAN IV Plus.
- Documentation: None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
- Data Base: Preparation time is 2 days.
- CPU time per Cycle: 10 minutes.
- Comments: Status of Model - completed; debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: Aircraft Sortie Rate Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: SAC Conventional Warfare.

PROPONENT: HQ SAC/XPAO coordinated with HQ SAC LGMM.

POINT OF CONTACT: Richard A. Jourdan, HQ SAC/XPAO, Commercial (402) 294-2851, AV 271-2851.

PURPOSE: Derive conventional planning factors; estimate aircraft requirements to support operations plans, assist HQ SAC/DOO/LGM in deriving aircraft sortie rate requirements and provide quantitative information for review and change of USAF War Mobilization Plan, Volume V (WMP-5) aircraft sortie rate factors.

DESCRIPTION: The Aircraft Sortie Rate Model is an expected value mode that has been adapted from a prior developed simulation model. The expected value model was adapted to provide more responsive information to the SAC staff. The expected value model was specifically designed to take into account time interval distributions. Its results are within 5% of the simulation model. The models were initially based on the KC-135 and B-52D SAC surge tests of 1978. The models have been used since 1981. The expected value model has replaced the simulation model in 1987. The model has been validated with the B-52G BULL RIDER exercise in 1988.

RECENT STUDIES USING THIS MODEL: Draft Conventional Planning Factor Document. Currently being used in the SAC Surge and Sustained Conventional Bombing Study.

INPUT: 30 logistic factors and operations aircraft takeoff schedule and sortie lengths.

OUTPUT: Aircraft sortie rates, average sortie duration, average maintenance/repair time, average delays for scheduled takeoffs, and above delays by scheduled takeoff times for detailed analysis of efficiency of takeoff schedule.

LIMITATIONS: Has not been validated for surges employing new and planned weapons. Does not consider limitations due to aircrew, fuel and munition shortages.

HARDWARE AND SOFTWARE: Z-248 type micro processor. Basic software.

Documentation: In draft form by XPAT.

Time Requirements: Requires time to assemble inputs by trained analyst, input and operating time within 15 minutes.

SECURITY CLASSIFICATION: Program unclassified, classification of results depend on project.

Frequency of Use: Monthly.

Users: HQ SAC/XPA/XPS/LGM/DOO.

Comments: Plan to use model to validate development of the Enhanced Sorts Capability Assessment Module (ESCAM) for SAC proposed by Air Force XOXOS.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: AIRRAD - Fallout Prediction System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Atmospheric Sciences Laboratory, ATTN: SLCAS-AE-A, White Sands Missile Range, NM 88002 5501.

POINT OF CONTACT: Mr. David Sauter, (505) 678-2078, AV 258-2078.

PURPOSE: AIRRAD is used primarily to determine the dimensions of the nuclear hazard to low flying aviators from single threat nuclear attacks due to the close-in fallout. It is mainly an operation support tool, although it can also be used as a research and evaluation tool.

DESCRIPTION:

Domain: Land and air.

Span: Regional.

Environment: Models effects of weather but not terrain.

Force Composition: N/A.

Scope of Conflict: Nuclear.

Mission Area: Those involving nuclear usage.

Level of Detail of Processes and Entities: Effects on individual aircraft are modeled through the input of aircraft-specific flight characteristics such as flight speed.

CONSTRUCTION:

Human Participation: Required for decisions (waited for).

Time Processing: Dynamic, time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: N/A.

LIMITATIONS: No complex, terrain influenced wind.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Meteorological variables and pertinent parameters describing the nuclear attack (e.g., height of burst, burst yield, etc.).

OUTPUT: Printout of length, width, and height of the nuclear hazard to aviators; graphic display of radiation contours at different heights; and accumulated dosage along user-specified flight paths.

HARDWARE AND SOFTWARE:

Computer:	IBM PC or compatible.
Storage:	350 K on a floppy diskette.
Peripherals:	Printer (optional) and a graphics terminal.
Language:	Turbo Pascal.
Documentation:	Technical report/users guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Already exists or can be easily obtained.

CPU time per Cycle: Negligible; runs on a PC in minutes.

Data OutPut Analysis: None; results are easily understood.

Frequency of Use: Variable.

Users: Defense Nuclear Agency and Atmospheric Sciences Laboratory.

Comments: None.

TITLE: AITTR - AI Target Tracking Radar.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To test response to ECM.

INPUT: CSMP model. User supplied FORTRAN ECM subroutines.

OUTPUT: Azimuth and elevation tracking errors.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780-782. Requires array processor.
Storage: 50K Bytes; memory requirements: 1M Bytes of 8 Bits.
Language: FORTRAN IV Plus.
Documentation: None.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is Secret.

GENERAL DATA:
Data Base: Preparation time is 2 days.

CPU time per Cycle: 5 minutes on VAX computer.

Comments: Status of Model - completed; debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: ALARM - Advance Low Altitude Radar Model.

DATE IMPLEMENTED: July 1987.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: ALARM is a research and evaluation tool that evaluates the effectiveness of various aircraft configurations against selected air defense systems. ALARM provides an output of S/I values along a flight path or a detection contour plot.

DESCRIPTION:

Domain: Land and air.

Span: Local and individual.

Environment: Terrain relief.

Force Composition: One-on-one engagements.

Scope of Conflict: Pulsed, pulse doppler, and continuous wave radars.

Mission Area: Conventional missions involving radar aircraft engagements.

Level of Detail of Processes and Entities: ALARM uses the radar range equation approach; ALARM is not a signal level simulation. The radar system description contains transmitter, receiver and radar antenna characteristics. The environment describes ground clutter characteristics, clutter masking, multipath, atmospheric refraction, and jamming cross section. The target description contains the target flight path and the radar cross section. Both onboard and standoff jamming systems are modeled. This model provides the detection performance of ground-based radar systems against aircraft targets.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, closed form.

Treatment of Randomness: Basically deterministic; statistical clutter calculations.

Sidedness: One-sided.

LIMITATIONS: ALARM is not a waveform model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Radar, target, jamming characteristics; onboard jammer antenna pattern data; target flight path data.

OUTPUT: Signal-to-interference ratio data, contour plot data, SPEED output file, specific radar and target geometry data and signal data.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780 with VMS and floating point accelerator.
Storage:	1,209 blocks.
Peripherals:	Device for plotting GKS graphics.
Language:	FORTRAN 77.

Documentation: ALARM User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: 15 minutes needed to prepare data base.

CPU time per Cycle: Average of 24.61 CPU seconds (varies with input parameters).

Data Output Analysis: Hardcopies of data. Plot routines needed to display plot data.

Frequency of Use:

Users: Primarily WL/AAWA.

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: ALARM 88 - Advanced Low-Altitude Radar Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1, SURVIAC.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543, (513) 255-4429.

PURPOSE: ALARM evaluates the effectiveness of various aircraft configurations against selected air defense systems. In its most frequent role, ALARM aids in survivability analysis for either one-on-one or force-on-force radar aircraft engagements.

DESCRIPTION: ALARM plays an integral part in studying the survivability of an aircraft encountering hostile defenses. In the case of ground-based defense systems, the effectiveness of the aircraft to survive directly depends upon:

The ability of the defense system to detect/track the aircraft, and

The ability of the defense system to direct a weapon (missile, anti-aircraft round, laser, etc.) within lethal range of the aircraft.

Generally, detection of the aircraft may occur by three modes; namely, by infrared, radar receivers, or optically. ALARM is directed at supplying data on the first area above for the radar detection mode. The primary application of ALARM is to evaluate target detection range as a function of the environment. Based on radar cross section, radar performance characteristics, environment, and geometry, ALARM may be used to predict areas of detection for surveillance radars, areas of detection and acquisition (initial lock-on) for tracking radars, and areas of continuous track-maintenance.

Low observable technology will stress the capability of air defense systems. To adequately assess the ability of defensive systems to detect, track, and engage low signature vehicles, high fidelity analysis tools are required. In particular, site-specific terrain effects such as masking, clutter, and multipath must be correctly simulated. The purpose of this version of ALARM is to incorporate this required fidelity.

To accurately and efficiently model the impact of terrain effects upon a radar's ability to detect/track low altitude, low observable aircraft, ALARM 88 incorporates the following:

- Site-specific terrain masking of the target and clutter patches.
- Multipath angles computed based upon digitized terrain. This version of ALARM will allow the determination of all (zero, one, or many) multipath points based on the actual terrain between radar and target.
- True round earth geometry and local coordinate systems to provide accurate angle measurements.
- Streamlined coding and computations.

INPUT: Required input includes standard radar parameters; aircraft velocity, radar cross section and altitude; and ECM characteristics. Radar antenna patterns are represented either by antenna gain functions in the azimuth and elevation planes or by tabular input of measured gain values. Similarly, radar cross section values are tabularly measured input values with resolution up to 0.1 degrees in both the azimuth and elevation planes.

OUTPUT: Output data is given graphically by a contour plot of the aircraft's detectability about a given defense site. Data may be generated in tabular form as a history of the received signal-to-total-interference ratio. Tables are produced with respect to time or to geographic location of the aircraft about a given radar site.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780, Ultrix.
Storage: 456 blocks.
Language: FORTRAN 77.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATE:
Time Requirements: Compilation time: Machine dependent; Typical run time: Dependent on selected mode, radar type, and increment sizes selected. From seconds to tens of minutes.

Users:

6510 TW/TSDE
6585 TG/RX
AFCSA/SASB
AFOTEC/OAN
ASD/XRHD
ASD/XRM
ASD/YSEE
ASDI
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Boeing Helicopters
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
Calspan Corporation
E-Systems, Greenville Division
FTD/SDJMM
GTE Government Systems Corporation
General Dynamics/Convair Division
General Research Corporation
Institute for Defense Analyses
Johns Hopkins Univ. Applied Physics Lab.
Litton/Applied Technology
Lockheed Aircraft Services Company
Logicon, Inc.
Loral Advanced Projects
Loral Electronic Systems
NASA Lewis Research Center
NATO
Naval Air Development Center
Naval Weapons Center
Naval Weapons Support Center
Nichols Research Corporation
Northrop Defense Systems Division
SAIC
Sanders Associates, Inc.
Survice Engineering Corporation
TRW/Military Electronics & Avionics Division

Texas Instruments
The Rand Corporation
Tracor Aerospace, Inc.
U.S. Army SMO, SLCSM-AT
USAF ESD/ICZ
United Technologies
WL/AAWA-1
WL/TXAA

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: ALARMPP - Pulse-to-Pulse Version of the Advanced Low Altitude Radar Model with Site-Specific Terrain.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC), Suite 200, 700 Franklin Road, Marietta, GA 30061.

POINT OF CONTACT: Mark D. Bond, SAIC, (404) 426-9359.

PURPOSE: The purpose of ALARMPP is to aid the radar systems analyst in the study of radar detection phenomenology.

DESCRIPTION:
Domain: Land and sea.

Span: One aircraft on the radar.

Environment: Associated off-line program builds a mask file from Defense Mapping Agency terrain elevation data for use in target masking and clutter calculations.

Force Composition: Single element BLUE vs. RED or RED vs. BLUE.

Scope of Conflict: Accommodates any type of electronic warfare, target acquisition, or tracking radar. Includes tracking loops methodology and an error-nulling feedback algorithm designed to simulate monopulse angle as well as range and doppler tracking.

Mission Area: Single penetrator with jammer against a single radar.

Level of Detail of Processes and Entities: Lowest entity modeled is a radar subsystem: transmitter, pulse doppler or MTI circuit, noncoherant integrator, gain control. Pulse doppler and MTI processing implemented as actual system software.

CONSTRUCTION:
Human Participation: Not required or permitted.

Time Processing: Dynamic real-time emulation.

Treatment of Randomness: Deterministic; random noise implemented in both phase and amplitude.

Sidedness: Symmetric.

LIMITATIONS: Does not model range tracking.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Moving target detector (MTD: MTI followed by pulse doppler) capability and extended target and range tracking will be added.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with a VMS operating system.
Storage:	ALARMPP executable = 125,000 bytes. Input files = 75,000 bytes each (including antenna patterns). Mask files = 65,000 each (1 deg x 1 deg). Terrain executable - 30,000 bytes. TERMSK executable = 23,000 bytes. ALARMPP terrain elevation data files = 500,000 each (1 deg x 1 deg). DMA terrain elevation files = 1,500,000 bytes each (1 deg x 1 deg).
Peripherals:	No peripheral support required for operation. A graphics display terminal to view templates is recommended.
Language:	FORTRAN.
Documentation:	A user's manual and input guide are available.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base construction time is minimal provided that preparation is performed by a qualified radar analyst.

CPU time per Cycle: Depends on purpose; may range from several CPU minutes to several CPU hours.

Data Output Analysis: Extensive knowledge of radar processing required.

Frequency of Use: Extensive use by airframers in analysis of low observables (LO) design.

Users: N/A.

Comments: Configuration is controlled by SAIC.

TITLE: ALARMSS - Advanced Low Altitude Radar Model with Site-Specific Terrain.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Electronic Combat Digital Evaluation Simulation Center, Wright-Patterson Air Force Base (WPAFB), OH 45433-6543.

POINT OF CONTACT: Mark D. Bond, Science Applications International Corporation (SAIC), (404) 426-9359.

PURPOSE: The purpose of ALARMSS is to determine the detectability of an aircraft with a given cross section in an environment with limited clutter. Detection templates for user input aspect angles around the aircraft are often fed to mission-level and campaign-level models such as SPEED and COMMANDER.

DESCRIPTION:

Domain: Land and sea.

Span: One aircraft on one radar.

Environment: An associated off-line program builds a mask file from Defense Mapping Agency (DMA) terrain elevation data for use in target masking and clutter calculations.

Force Composition: Single element BLUE vs. RED or RED vs. BLUE.

Scope of Conflict: Accommodates any type of electronic warfare, target acquisition, or tracking radar, although tracking radar is limited to detectability only. Aircraft are represented by Swirling/Barton theoretical fluctuation models.

Mission Area: Single penetrator with jammer against a single radar.

Level of Detail of Processes and Entities: Lowest entity modeled is radar subsystem: transmitter, pulse doppler or MTI circuit, noncoherent integrator, gain control. Pulse doppler and MTI processing limited to single spectral return in user-defined filter. Target fluctuation models limited to Swerling 1-4, Chi-squared, Weinstock, and nonfluctuating. Clutter reflectivity data is from Lincoln Labs; limited to 9 types of land form and 5 types of land cover to form 45 combinations of land state.

CONSTRUCTION:

Human Participation: Not required or permitted.

Time Processing: Dynamic, closed form solution. Determines detectability of aircraft of constant heading for 0-360 degrees viewing aspect angle over a user-specified distance.

Treatment of Randomness: Deterministic; random noise sums to the mean (deterministic) over an integration period.

Sidedness: Symmetric.

LIMITATIONS: Does not model angle, range, or doppler tracking. Target fluctuation limited to Swerling models 1-4, Chi-squared, Weinstock, or nonfluctuating.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Moving target detector (MTD: MTI followed by pulse doppler) and monopulse angle tracking will be added. Integration period algorithms for coherent jamming will be designed.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer: Designed to run on VAX with VMS operating system.

Storage: ALARMSS executable = 80,000 bytes.
Input files - 75,000 bytes each (including antenna patterns).
Mask files 65,000 each (1 deg x 1 deg).
Terrain executable - 30,000 bytes.
THERMSK executable = 23,000 bytes.
ALARMSS terrain elevation data files = 500,000 each (1 deg x 1 deg).
DMA terrain elevation data files = 1,500,000 bytes each (1 deg x 1 deg).

Peripherals: No peripheral support required for operation. A graphics display terminal to view templates is recommended.

Language: FORTRAN.

Documentation: A user's manual and input guide are available.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base construction time is minimal provided that preparation is performed by a qualified radar analyst.

CPU time per Cycle: Depends on number of simulation points. A 100 km range simulation performed at 1-degree intervals would require approximately 5 CPU minutes on a 4-MIP machine.

Data Output Analysis: Depends on level of engineering skills.

Frequency of Use: Extensive use by airframers in the analysis of low observables (LO) design.

Users: N/A.

Comments: Configuration is controlled by SAIC under contract to the Electronic Combat Digital Evaluation Systems at WPAFB, Ohio.

TITLE: ALB-XMOD - AirLand Battle Expert Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Vector Research, Incorporated, PO Box 1506, Ann Arbor, MI 48106.

POINT OF CONTACT: Dr. George Miller, (313) 973-9210.

PURPOSE: ALB-XMOD is a research and evaluation tool designed for dealing with combat development issues (alternative doctrinal concepts). It has also been used to address issues of force capability and requirements (e.g., force structure issues).

DESCRIPTION:

Domain: Land and air.

Span: Can vary from division through theater.

Environment: Terrain cells of a width sufficient to conduct an independent defense (of approximately battalion size) and distinguish differences in battlefield trafficability and intervisibility. Terrain features, such as rivers and urban areas, can also be represented. Weather conditions, which are uniform throughout the battlefield and are updated each hour, can affect both trafficability and visibility for air and ground operations.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional AirLand combat mission areas, with limited treatment of combat service support missions.

Level of Detail of Processes and Entities: Unit resolution is user specified (e.g., battalion maneuver unit resolution for a corps-level scenario). In tactical air operations, resolution is to user-specified individual flight group (typically two to four aircraft). In most process modeling, the level of system resolution is the individual system type in the unit.

CONSTRUCTION:

Human Participation: The model can operate in either of two modes. In one mode, human participation is used for high-level decisions describing an operational concept. Once an operational concept has been developed, campaigns can be replayed without gamers, varying individual details for analysis purposes.

Time Processing: Dynamic, time and event stepped. Eight nested clocks are used to reduce execution time while allowing statuses to be updated at appropriate frequencies.

Treatment of Randomness: Deterministic; generates a value as a function of an expected value.

Sidedness: Two-sided, symmetric.

LIMITATIONS: No naval warfare; no chemical, biological, or nuclear warfare; limited treatment of logistics.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: (1) System performance capabilities; (2) initial force and supply inventory and organizational data, and a schedule of unit and resource arrivals; (3) data describing the environment; (4) tactical decision rules; and (5) initial intelligence information.

OUTPUT: The total trajectory of all important statuses (missions and activities, force inventories and attrition, unit locations and movement, supply deliveries and consumption, etc.) during a campaign are stored by the model for later summary and display by postprocessors.

HARDWARE AND SOFTWARE:

Computer:	Most applications have been conducted on either a Concurrent minicomputer or a SUN workstation.
Storage:	Approximately 2.5 megabytes.
Peripherals:	No special peripherals are required.
Language:	FORTRAN.
Documentation:	Extensive documentation exists for the basic underlying model (VECTOR-2). Summary documentation describes modifications to this model resulting in ALB-XMOD.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Data modifications to an existing scenario for a new study typically require one to a few person months of effort, depending on the extent of the changes. Development of an entirely new scenario can require a person year or more.

CPU time per Cycle: Two to five minutes per day of simulated combat on the SUN workstation, depending on complexity of the scenario.

Data Output Analysis: One to several person days of effort are required for a thorough analysis of the results of a several-day, corps-level run.

Frequency of Use: One or two studies per year.

Users: VRI has used ALB-XMOD for several U.S. Army agencies and for the National Defense University.

Comments: ALB-XMOD was developed from VECTOR-2 to incorporate Army AirLand Battle doctrine and tactics. The basic physical process models of VECTOR-2 were unchanged, but the capability to represent new tactical doctrine was incorporated. Added features include new and improved play of Blue offensive operations, including counteroffensives at tactical and operational levels; deep attack by maneuver forces and helicopters; improved synchronization of efforts around objectives; and an expert/gamer interface.

TITLE: ALBAM - Air Land Battle Assessment Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Engineering level analysis.

PROPONENT: General Dynamics/Fort Worth, Combined Arms Systems Engineering Center, Independent Research and Development Project, P.O. Box 748 MZ 4091, Fort Worth, TX 76101. Used by AFOTEC and The Center for Strategic and International Studies (CSIS).

POINT OF CONTACT: Glenn E. Weissinger, (817) 935-1117.

PURPOSE: ALBAM is a theater level man-in-the-loop simulation designed to analyze the contributions and interactions of existing and proposed weapon, sensor, and C^3I systems. It can also be used to evaluate the effectiveness of the Operational Art being employed by the users.

DESCRIPTION:
Domain: Land and air, with limited naval.

Span: Theater.

Environment: DMA Digital Terrain Elevation and Digital Features Analysis Data; day, night, and weather operations; CIA World Data base II road and river networks; Latitude/Longitude, UTM, and Hex coordinate systems.

Force Composition: Joint and Combined Forces, Blue and Red.

Scope of Conflict: Virtually all air and ground weapon systems including sensor, intelligence, communication, and logistics systems.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Assets represented to the individual equipment, sensor, and weapon level. Ground forces aggregated to companies, divisions, and regiments; air forces aggregated to flights. All functions - air, ground, sensor, intelligence, logistics, attrition, and SOF are totally integrated. Interfaces to specialized simulations exist.

CONSTRUCTION:
Human Participation: Required for decisions and data analysis.

Time Processing: Dynamic, time-stepped. Progresses through the scenario at an umpire-specified ratio of exercise time to real time.

Treatment of Randomness: All attrition stochastically based using probability of kills (PKs) generated from accepted operations research models.

Sidedness: A two-sided, symmetric, reactive model.

LIMITATIONS: Accuracy of attrition limited by availability of models to generate PKs for engagements. Number of units in data base affects ability to achieve real time processing.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved direct-fire methodology, addition of naval capabilities, ongoing effort to improve real time performance and user interfaces. Automated data base construction tool.

INPUT: Scenario data on unit compositions, locations, and capabilities. Operational characteristics of sensors, equipment, and weapons. Interactive user orders.

OUTPUT: Graphic and tabular interactive unit movement and attrition information to users. Event data and outcomes for analysis of asset effectiveness and interactions.

HARDWARE AND SOFTWARE:

Computer:	Hosted on 2 clustered VAX 8800's with VMS 5.0 operating system.
Storage:	128 MB of RAM, twenty RA60 205 MB removable disks.
Peripherals:	One IRIS Silicon Graphics workstation and two DEC VT terminals per command function. Two line printers, one laser printer, and three Tektronix graphics printers. Separate LAN of SUN 386i, SUN 3, and SUN 4 workstations.
Language:	FORTRAN 77 and C.
Documentation:	Library of 50 documents including User's Guides, Methodology Manuals, and Specification Descriptions.

SECURITY CLASSIFICATION: Unclassified software; data bases are usually classified.

GENERAL DATA:

Data Base: Data base generation requires two to six months depending on scenario.

CPU time per Cycle: Depends on data base size and player configuration. Designed for 1:1 simulation.

Data Output Analysis: Performed on Sun workstations with the aid of ORACLE, SAS, Harvard Graphics, and customized software packages.

Frequency of Use: Varies according to current contracts.

Users: AFOTEC, CSIS, General Dynamics Divisions. Available to all military commands and offices.

Comments: ALBAM is designed to allow the simulation of all tactical assets. However, it is possible to integrate specialized simulations with ALBAM. The simulation can also be used to stimulate real world equipment.

TITLE: ALES - AirLand Engagement Simulation.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: McDonnell Douglas Helicopter Company, 5000 E. McDowell Road, Mesa, AZ 85205.

POINT OF CONTACT: Scott Swinsick, (602) 891-8429 and/or Greta Robertson, (602) 891-8426.

PURPOSE: ALES is a few-on-few combat model which examines airborne and ground platforms and their associated weapons systems. Designed specifically for the analysis of helicopters, ALES is also capable of examining fixed wing aircraft, anti-aircraft weapons, and ground based targets in combat mission scenarios. ALES is used in trade-off studies to analyze the mission effectiveness of specific systems and an overall platform design.

DESCRIPTION:

Domain: Land and ground.

Span: Few-on-Few.

Environment: Related to inputs defining the weapons and sensor capabilities, aircraft performance, and initial conditions.

Force Composition: Red versus Blue.

Scope of Conflict: Conflict based on scenario definitions. Does not model nuclear or chemical weapons.

Mission Area: Examine typical helicopter and fixed wing mission profiles.

Level of Detail of Processes and Entities: Model can be utilized to examine entire weapons platform or specific sub systems. Can examine specific parameters (projectile time-of-flight, horsepower available, missile seeker field-of-view, etc.) and their effects on survivability. Can also compare entire systems (AH-1S, AH-64A, Mi-24, Mi-28, etc.) based upon mission effectiveness. High resolution models external to ALES define the inputs (Pk vs. range, detection range, performance limits) used to represent system capabilities.

CONSTRUCTION:

Human Participation: Input only. Batch execution.

Time Processing: Dynamic integration of equations of motion based on a specified time-step.

Treatment of Randomness: Endgame results determined using Monte Carlo methods or Co-Kill (expected value) mode.

Sidedness: Two-sided model with opponents of varying capability. Tactics can be varied to reflect offensive or defensive battle postures.

LIMITATIONS: Currently limited to 20 players, but easily modified to include larger force mixes. Clear air combat with line-of-sight and detection determined statistically based upon environmental conditions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of terrain based upon Defense Mapping Agency data. This will provide a real time graphics representation of the combat over a terrain data base (cockpit, plan, and perspective views).

INPUT: Initial conditions (x, y, z, velocity, heading), aircraft performance and weapons characteristics, detection/acquisition capabilities, and Pk capabilities against associated threats.

OUTPUT: Provides a time history of player trajectories, firing opportunities, and survivability. Data saved as a function of time for use in various plotting routines.

HARDWARE AND SOFTWARE:

Computer:	Currently hosted on Silicon Graphics 4D/80GT Workstation, DEC MicroVax II UNIX and VMS.
Storage:	20,250 blocks (10 megabytes) including data.
Peripherals:	Tektronix 4014 Emulator required for plotting, line printer, and terminal.
Language:	FORTRAN 77.
Documentation:	Analysts Guide well documented, User Guide poorly documented.

SECURITY CLASSIFICATION: Unclassified, but data is often classified.

GENERAL DATA:

CPU time per Cycle: Dependent upon integration time-step. At a time-step of 0.1 seconds, program runs near real time on MicroVax II.

Frequency of Use: Primary operations analysis tool at MDHC.

Users: Operations research engineers. Has been utilized on contract efforts with Army Aviation Technology Directorate, Army Aviation Systems Command, and Army Missile Systems Command.

TITLE: ALEx - Aircraft Loading Expert.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Operations Analysis (OA) Unit, Boeing Military Airplanes (PMA), P.O. Box 7730, M/S k80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: John E. Huffman, (316) 685-9669.

PURPOSE: ALEx determines feasible aircraft store loading configurations based on certain mission parameters. ALEx operates within the Knowledge Engineering Environment (KEE). The information on weapons, external tanks, pods, and suspension units is accessed by simulation models.

DESCRIPTION:
Domain: Model specific. (Supports air-to-air, air-to-surface, and special missions.)

Span: Model specific.

Environment: Model specific. (Supports many target and air environments.)

Force Composition: Model specific.

Scope of Conflict: Conventional weapons.

Mission Area: Combinations include close air support, air interdiction, sea control, airlift, and air refueling.

Level of Detail of Processes and Entities: Entity: Aircraft, external stores. Processes: Model specific.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Model specific.

LIMITATIONS: Limited by the domain and knowledge frame.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Stores driver for configuration control. Addition of other U.S. Air Force and U.S. Navy aircraft.

INPUT: Missions data includes length, aircraft, air environment, target environment, and standoff support.

OUTPUT: Loading configurations, store components, weights, and drags.

HARDWARE AND SOFTWARE:
Computer: APOLLO DOMAIN.
Storage: 400,000 blocks.
Peripherals: Printers and graphics plotters.
Language: DOMAIN COMMON LISP, KEE, and UNIX.
Documentation: Boeing published manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Aircraft/Relation specific. Usually two man-weeks per aircraft.

CPU time per Cycle: Model specific. Can take hours of CPU time, but most sessions are quick.

Data Output Analysis: Used only to manage information accessed by models.

Frequency of Use: Extensive access by simulation models.

Users: Tanker/Airlift group, BMA OA.

Comments: ALEx is a modular expert system that accesses aircraft knowledge bases. Current knowledge bases have been developed for multiple versions of the F-15, F-16, and F-14 fighters. Development of the F-18 knowledge-base is in progress. Future development for most USAF and USN fighters and bombers.

TITLE: ALIAS/MISSILE Eye View - Advanced IR Missile Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: USAF ASD, McDonnell Douglas Corp.

POINT OF CONTACT: Photon Research Associates (Alias): Mr. Jeff Johnson, (619) 455-9741; McDonnell Douglas (Missile Eye View): Mr. Al Parker, (213) 593-5814.

PURPOSE: Alias generates one-on-one missile vs. target flyouts and miss distances for IR missile systems with CCM capabilities; Spinscan, Conical-scan, and Array-scan seekers are available. Represents target aircraft as extended source. Missile Eye View provides a detailed graphical display.

DESCRIPTION:
Domain: Air (air-air) and Land (surface-air).

Span: Individual.

Environment: Atmospheric and terrain effects.

Force Composition: Element.

Mission Area: N/A.

Level of Detail of Processes and Entities: Entity: Single Aircraft with flare or towed decoy countermeasure vs. single missile system/seeker. Engagement includes missile CCMs; target extended body signature, hot parts, plumes, flares; seeker SNR, look angle, and target in FOV for Spin-scan, and Conical-scan seekers. Processes: Attrition.

CONSTRUCTION:
Human Participation: Not Permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic. no randomness unless ground clutter modeling is selected by the user.

Sidedness: One-sided.

LIMITATIONS: One-on-One only, significant preparation required for data bases.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Staring-array seeker, aerodynamic flare modeling.

INPUT: Target description file(signature data base).
MISRET missile sensor response data base.
Missile parameters data base (for each missile).
Flare parameters data base.
Aircraft flight path.
User input run conditions.

OUTPUT: Near-Visual Simulation with animated performance.

HARDWARE AND SOFTWARE:

Computer: (Alias) DEC VAX; (Missile Eye View) Silicon Graphics Iris-4D Workstation.

Language: FORTRAN 77, (Silicon Graphics) C.

SECURITY CLASSIFICATION: Unclassified computer code; classified inputs and outputs.

GENERAL DATA:

Data Base: 1-3 man-months.

CPU time per Cycle: 50 minutes per engagement on Vax 3800 for Alias; Missile Eye View postprocessor runs in real time.

Data Output Analysis: Visual.

Frequency of Use: Daily.

Users: ASD/XR, McDonnell Aircraft Co, Douglas Aircraft Co., Northrop.

TITLE: ALWSIM III - Army Laser Weapon Simulation Model.

DATE IMPLEMENTED: August 1989.

MODEL TYPE: Force-on-force or many-on-many.

PROPONENT: HQ, U.S. Army Laboratory Command (LABCOM).

POINT OF CONTACT: HQ, U.S. Army LABCOM, ATTN: AMSLC-TP-AS (CPT Mike Barton), 2800 Powder Mill Rd., Adelphi, MD 20783-1145, (301) 394-4650/2410/2411, AV 290-4650/2410/2411.

PURPOSE: ALWSIM III, originally developed by GRC in 1981/1982 to model the use of lasers on the modern battlefield, is now also ideal for parametric analysis of both laser and nonlaser next generational and notional systems.

DESCRIPTION: Computerized simulation of a brief, intense close combat situation based on realistic battlefield environment (HRS 1) using digitized terrain data. Plays obscuration due to artillery dust and smoke (EOSAEL 87), emphasizing accurate modeling of low-energy laser weapons. Utilizes armor, aviation, dismounted infantry (and their weapons), close air support, air defense, and fire support in a BLUE battalion vs. RED regimental battle. Other scenarios can be developed. Uses Carmonette terrain representation, LOS algorithms, vehicle movement modeling approach, and basic NVEUL target acquisition code, LELAWS, for laser damage determination; PHI for active acquisition modeling; and ADAGE incursion model for air defense weapon effects modeling.

Domain: Land warfare.

Span: 100 m x 100 m grid squares in a 16 square km section.

Environment: Land.

Force Composition: BLUE battalion vs. RED regiment.

Scope of Conflict: Conventional.

Mission Area: Force-on-force land warfare.

Level of Detail of Processes and Entities: Casualty figures given by single vehicles; round-by-round description of effects of firing; damage to individuals; movement is by groups but systems fire individually.

CONSTRUCTION:

Human Participation: None.

Time Processing: Dynamic, mainly event-step but some time-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided.

LIMITATIONS: EOSAEL 80 is used in the model. The air-air and ground-air battle not fully developed. Fixed wing aircraft not fully utilized in battle; mainly used to drop ordinance on ground units. Logistics and communications not played.

PLANNED IMPROVEMENTS AND MODIFICATIONS: An SOW is being initiated to update EOSAEL 80 to EOSAEL 87 and to provide ALWSIM III to AMSAA to operate on a UNIX VAX. The Survivability Management Office plans to upgrade the ground-air and air-air aspects with a joint SOW between KETRON and SPARTA, Inc.

INPUT: When HRS1 scenario used, inputs required in following categories: vehicle, weapon, sensor, and laser characteristic; pK tables for all weapon systems; movement rates; and environmental data (default or user input).

OUTPUT: Troubleshooting reports help debug program. Battle summaries are of: conventional, direct fire kills; indirect fire kills; kills by fixed wing aircraft; laser engagement assessments; laser engagement results; ammo depletion; laser weapon effectiveness; force-on-force effectiveness; and conditions at battle termination. A report is prepared for the replication only that provides a summary of conventional, direct fire weapon firings; a breakdown of firings and kills by weapon/target type; a summary of laser weapon firings; and force dispositions at battle termination.

HARDWARE AND SOFTWARE:

Computer: VAX with VMS operating system or CONVEX C-1, unvectorized.

Storage: N/A.

Peripherals: Standard keyboards and printer.

Language: FORTRAN is the basic language. A version of FORTRAN, CIFTRAN, is facilitates running the model.

Documentation: User's manual, user's guide, and analyst guide.

SECURITY CLASSIFICATION: Unclassified without data. Model uses a classified reference sheet (secret) that enables the user to run the model in an unclassified mode even with the data input.

GENERAL DATA:

Time Requirements: 3600/iteration to run HRS1, a 20 min. BLUE battalion vs. RED regimental battle. Ten to 20 iterations per case required.

Data Base: Two man-months.

CPU time per Cycle: Seven minutes for 20-minute battle.

Data Output Analysis: Printout.

Frequency of Use: N/A.

Users: HQ, U.S. Army LABCOM, NVEOL and CECOM (2Q FY89), and AMSAA (3Q FY89.

Comments: Architecture: it is not interactive. Processes are modeled as discrete events occurring instantaneously by sampling assumed distributions. Repetition of simulated battle yields distribution of outcomes. A simulation clock proceeds from event to event rather than in fixed steps. Simulation inputs are provided either by user in a data base or by recognized subroutines. A developed scenario uses preplanned movement routines for air and ground vehicles, artillery fires, and obstacles.

TITLE: AMM - Advanced Missile Model.

DATE IMPLEMENTED: 1979 (rev 1990).

MODEL TYPE: Analysis.

PROPONENT: AFSAA/SAS, Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Knieriem DSN 225-9018 or Commercial (202) 695-9018.

PURPOSE: The AMM models portions of the SIOP process. It can compute range and footprint capabilities for both existing and future ballistic missile systems. These data bases, together with a generic weapon allocation, are used by the AMM to apply a sortie laydown to a target set. The model can also create a timing plan accounting for fratricide considerations computed by the Nuclear Weapons Effects Model (NWEM), which is incorporated in the AMM. Finally, the AMM will compute a variety of measures of effectiveness (MOEs) to analyze the timed laydown.

DESCRIPTION:
Domain: Land, air, sea.

Span: Global.

Environment: N/A.

Force Composition: Current or future RED and BLUE nuclear land and sea systems.

Scope of Conflict: Global nuclear missile exchange.

Mission Area: Land- and sea-based ballistic missiles (nuclear).

Level of Detail of Processes and Entities: Scenarios can be as small as a single RV or as large as a SIOP-like laydown. Targeting data is scenario driven and can accommodate 50,000 potential installations. Processes are very high fidelity calculations of missile performance parameters.

CONSTRUCTION:
Human Participation: Required to input the missile design specifications, target sets, and for the conceptualizing of attack and exchange scenarios.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Single-sided; either RED or BLUE forces during a single scenario.

LIMITATIONS: Cumbersome input modules make the model difficult to work with. Considerable training is required before efficacious application is possible. Multiple runs are required to accomplish a complete scenario.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Making the input modules more user friendly. Transporting many of the AMM functions to microcomputers using UNIX V operating systems.

INPUT: Missile designs and specifications, missile launch points, number and size of nuclear weapons, targets, planning factors, NWEM data, exchange scenarios.

OUTPUT: Range and footprint data, sortie laydown (assignments), force timing, MOEs.

HARDWARE AND SOFTWARE:
- Computer: IBM 3090 with MVS-XA.
- Storage: System requires 10 MB memory storage.
- Peripherals: TSO terminals with SPF.
- Language: FORTRAN, COBOL, and JCL.
- Documentation: User's manual available.

SECURITY CLASSIFICATION: Unclassified (without data base); one Secret CEP subroutine.

GENERAL DATA:

Data Base: One to three weeks.

CPU time per Cycle: Variable; 5-150 CPU minutes.

Data Output Analysis: Variable.

Frequency of Use: Depends on analytic requirements.

Users: AFSAA/SAS.

TITLE: AMM - Army Mobility Model.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: Commander and Director, U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-GM-L, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

POINT OF CONTACT: Mr. Donald D. Randolph, 601-634-2694.

PURPOSE: Predicts on- and off-road mobility of combat and tactical vehicles for use in evaluating effectiveness of vehicles in specified operational scenarios.

DESCRIPTION:

Domain: Mobility of ground vehicles.

Span: Regional, local and individual.

Environment: Considers terrain relief, weather, and terrain cultural features.

Force Composition: Components.

Scope of Conflict: Predicts mobility of red and blue vehicles.

Mission Area: Ground vehicles.

Level of Detail of Processes and Entities: Single vehicle performance; comparison of performance of two or more vehicles.

CONSTRUCTION:

Human Participation: Human participation required for decision and processes, continues to run without a decision.

Time Processing: Static.

Treatment of Randomness: Deterministic model.

Sidedness: One-sided.

LIMITATIONS: Limited to single vehicle mobility predictions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Mobility performance on frozen rivers, convert to stochastic process; multi-vehicle, multi-pass.

INPUT: Vehicle characteristics, terrain data base and scenario conditions.

OUTPUT: Produces statistical speed data for a vehicle, scenario, and specific area or speed maps for vehicle in specific area.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX-VMS, IMB-PCs 386 or better, CRAY-UNIX.
Storage:	25 MB required.
Peripherals:	Printer and monitor.
Language:	C, FORTRAN 77 and UNIX script language.
Documentation:	Each of the three modules has a manual describing the code and how to run. Much background material is referenced.

SECURITY CLASSIFICATION: None.

GENERAL DATA:

Data Base: Vehicle data 10-20 man hours per vehicle (most existing vehicles already are prepared. Terrain data preparation of a quad-sheet size area (25x25 km) takes approximately 1 hr to prepare from DMA's Interim Terrain Data Base.

CPU time per Cycle: Typical data set with 3000 terrain descriptions range from 450 secs to 5 secs.

Data Output Analysis: Statistical reports produced as primary program output. Many items are available for import into GIS systems if desired.

Frequency of Use: When update needed.

Users: WES, AMC, TRADOC, DOD, COE, NATO, etc.

Comments: AMM is the same as the NATO Reference Mobility Model (NRMM) at this time but may change if necessary to meet USA's requirements. Changes are usually recommended as additions to NRMM are only periodically (about 18 months) approved for use in NRMM.

TITLE: ANGEL - Aids to Navigation Event-Step Logistics Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Coast Guard Research and Development Center, Avery Point, Groton, CT 06340-6096.

POINT OF CONTACT: Leonard Kingsley, (203) 441-2649, FTS 642-2649.

PURPOSE: The ANGEL simulation model was developed to evaluate alternative buoy tender designs of differing characteristics in realistic operational environments.

DESCRIPTION:
Domain: Coastal and ocean.

Span: Can be used for any region for which required data is available.

Environment: Uses simulated sea state and visibility data.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: A tender's activities are broken up into several processes: docked transit, anchored, working buoys. The process the tender undertakes depends on a series of decision variables (e.g., tender location, current tender state, sea conditions, buoy maintenance schedule).

CONSTRUCTION:
Human Participation: Only required for initiating a simulation run. Program is not designed to interact with user during processing phase. All decisions including the routing of the tender are taken care of within the program.

Time Processing: N/A.

Treatment of Randomness: The sea state is modeled by several Markov matrices, one for each month, determined using NOAA buoy data. The visibility is modeled by multiple Markov matrices, by month and by 3-hour time periods in a day, determined using local airport data.

Sidedness: N/A.

LIMITATIONS: Single mission (ATON) and single tender working a given set of buoys.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Adding logistics capability and a process for maintenance of the tender itself. Knowledge Support System is being developed as a front end to enhance user-friendliness.

INPUT: Polygons outlining navigable waters for the tender within the region being simulated, external event weather files regarding wave height and visibility for the region, tender characteristics, port data, and buoy data.

OUTPUT: MOE report, animated graphics, raw data to be used in Postprocessor.

HARDWARE AND SOFTWARE:

Computer: VAX computer with VMS operating system. Suggest using a machine with 2.7 MIPS or greater, dedicated if possible.

Storage: Dependent upon the number of tenders and regions involved.

Peripherals: N/A.

Language: SIMSCRIPT II.5, FORTRAN.

Documentation: Fully commented code, analyst-level report, programmer level installed in the Knowledge Support System.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Dependent upon data base size, the length of time being simulated, and the computer system being used. Using a 2.7 MIP dedicated VAX workstation to make 30 iterations of 365 day spans (field of buoy size was 156), it takes about 12 hours to complete per tender.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: N/A.

Comments: None.

TITLE: APM - Advanced Penetration Model.

DATE IMPLEMENTED: 1972.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SASB), The Pentagon, Room 1431, Washington, DC 20330-5420.

POINT OF CONTACT: Maj Terry Young, AFCSA/SASB, (703) 695-3599, AV 225-3599.

PURPOSE: The APM is a theater-level, complex, digital simulation of conflict between U.S. penetrators and enemy defenses. It is used to identify force structures that are most effective against a range of defenses.

DESCRIPTION:

Domain: Land and air.

Span: Global.

Environment: Smooth earth (radar clutter accounted for by applying degrade to radar).

Force Composition: BLUE strategic nuclear air-breathing forces vs. RED defensive forces (SUAWACS, EW/GCI, AIs, and SAMs).

Scope of Conflict: Nuclear.

Mission Area: Strategic nuclear bombardment.

Level of Detail of Processes and Entities: APM can track individual penetrators from launch through Airborne Warning and Control System, EW, GCI, and interceptor SAM coverage and from the target areas to recovery bases. It models each penetrator's exposure to radar, calculates the results of any engagement that occurs, and then aggregates the results for the entire force.

CONSTRUCTION:

Human Participation: Required for refinement of mission plan. Mission planning is an iterative process. Each run is checked for reasonableness, then adjusted and rerun as necessary. Human participation is not required for air battle.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Uses both deterministic and Monte Carlo techniques. Events such as entrance into and exit out of radar and SAM coverage and fighter commitment are the result of geographic and spatial relationships. However, the actual detections and kills by fighters and SAMS are determined by Monte Carlo techniques.

Sidedness: Two-sided, asymmetric, one side nonreactive (penetrator is routed around known threats, but does not react to unbriefed threats).

LIMITATIONS: Interrelated data structures and complex, cumbersome code make the model very difficult to work with. Considerable analyst experience is required to adjust model and data to represent low observables.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None - model is being archived.

INPUT: RED and BLUE force descriptions including locations; capabilities; one-on-one probabilities of detection, conversion, and kill; and degrades to these probabilities due to various countermeasures.

OUTPUT: Plots of sortie tracks, survivability and engagement reports, and output data banks of categorized information that the user can statistically analyze.

HARDWARE AND SOFTWARE:
- Computer: IBM 3081 With MVS-XA.
- Storage: The largest module requires 8000K of core.
- Peripherals: TSO terminals with SPF, Calcomp drum plotter, an IBM P3800 laser printer, and the capability to send output to microfiche.
- Language: Majority is FORTRAN.
- Documentation: User's guide available.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:
Data Base: Three to five man-months.

CPU time per Cycle: Mission planner modules take from 15 to 180 CPU minutes. The simulator module generally requires 120 CPU minutes.

Data Output Analysis: Varies.

Frequency of Use: Varies depending on SASB analytic requirements.

Users: SASB.

Comments: None.

TITLE: Application of Error Analysis to Target Location System.

DATE IMPLEMENTED: 1985

MODEL TYPE: Analysis.

PROPONENT: CECOM AMSEL-PL-SA, Fort Monmouth, NJ 07703-5000.

POINT OF CONTACT: Mr. Edwin Goldberg, (201) 532-3646, AV 992-3646.

PURPOSE: This research and evaluation tool computes the elliptical errors associated with target location by angle of arrival measurements made at two sensor locations.

DESCRIPTION:

Domain: Any combination of the identified items.

Span: Local.

Environment: Capability limited by terrain features.

Force Composition: Component and element.

Scope of Conflict: Conventional.

Mission Area: Air, land, and sea.

Level of Detail of Processes and Entities: Two sensor systems.

CONSTRUCTION:

Human Participation: Required to provide input data.

Time Processing: Static.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: One-sided.

LIMITATIONS: Single target.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Angle measurement error of sensors, self location error of sensors, placement of sensors, and location of emitters.

OUTPUT: Elliptical error geometry and estimate of circular error probable.

HARDWARE AND SOFTWARE:

Computer: Any.
Storage: Minimum storage required.
Peripherals: Printer.
Language: FORTRAN.
Documentation: "A Case for Error Analysis," Proceedings, 24th Annual U.S. Army Operations Research Symposium 1985 and "Application of Error Analysis to Target Locating Systems," Proceedings, 25th Annual U.S. Army Operations Research Symposium 1986.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Negligible.

Data Output Analysis: Computer output is self-instructive and complete.

Frequency of Use: N/A.

Users: CECOM, Fort Monmouth, NJ.

Comments:

TITLE: ARGUS - Advanced Realtime Gaming Universal Simulation.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Strategic Defense Initiative Organization, National Test Bed Joint Project Office (SDIO/NTEJPO), Falcon AFB, CO 80912

POINT OF CONTACT: Maj. William Koenitzer, (719) 380-3273.

PURPOSE: ARGUS is used to support Ballistic Missile Defense concept of operations development and refinement by analyzing the human-in-control issues associated with the employment of a future Strategic Defense System (SDS). It serves as the primary interface between the eventual SDS users and the SDS element developers.

DESCRIPTION:
Domain: Space.

Span: Global.

Environment: Spherical earth, solar blinding and earth limb effects, limited atmospheric effects.

Force Composition: Blue Ballistic Missile Defense Systems, Red strategic and tactical ballistic missiles, Blue Strategic Offensive Forces. National Command Authority to Army or Air Force Operations Centers.

Scope of Conflict: Nuclear and non-nuclear.

Mission Area: Global Ballistic Missile Defense, National Ballistic Missile Defense, and Limited Theater Ballistic Missile Defense.

Level of Detail of Processes and Entities: Each individual operator and each individual missile, sensor, and weapon is modeled. Each communication link between the operators is modeled, but the links between the individual sensors, weapons, and battle managers is not. Logistics modeling of element failures can be entered during simulation run time.

CONSTRUCTION:
Human Participation: Required for decisions and processes. Simulation continues to run in real time regardless of receiving any decisions. Both red and blue teams are interactive.

Time Processing: Dynamic, time and event stepped model.

Treatment of Randomness: Missile launch detection, missile type identification, missile state vector determination, RV discrimination, missile kills and kill assessments are determined by Monte Carlo based on element design parameters.

Sidedness: Two-sided, symmetric model. Can be operated by as many as 50 operators.

LIMITATIONS: Does not model any of the proposed theater ballistic missile defense elements. Does not model cruise missile or aircraft threats. Trajectory and signature data for Blue offensive forces is notional.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Simulation is updated every six months to reflect the latest USSPACECOM Ballistic Missile Defense CONOPS and proposed SDS force structure. Modifications include new information displays, decision aids, element controls, battle management, Preplanned Response Options, and player positions.

INPUT: Large number of configuration files which define elements, element capabilities, and available threats.

OUTPUT: Decisions and outcomes are recorded and post processed for further analysis.

HARDWARE AND SOFTWARE:

Computer:	CRAY 2, IBM 3090.
Storage:	100 CRAY Blocks.
Peripherals:	1 Silicon Graphics Workstation per player, Sun Workstation.
Language:	FORTRAN, C (exec and MMI), Ada (postprocessor).
Documentation:	Extensive 2167A documentation is updated with each six month version delivery.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: Approximately one 3-day simulation each 2 months.

Users: USSPACECOM, GE.

Comments: ARGUS models a future system for the analysis of proposed Concepts of Operation, and therefore is regularly modified to reflect the latest concepts. ARGUS development is funded by the SDIO and currently USSPACECOM is the only user. The tool is flexible enough however to be modified for analysis of Theater Ballistic Missile Defense or Offense/Defense Integration issues.

TITLE: Arrow.

DATE IMPLEMENTED: January 1991.

MODEL TYPE: Training and education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532. DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: Arrow is a subtheater planning game which replaced the JAGUAR wargame.

DESCRIPTION: Arrow is an automated, multisided, subtheater planning and employment exercise. It concentrates on Air Tasking Order (ATO) planning, ground and air logistics, and employment of special operations forces.

Domain: Air, ground, and naval operations.

Span: Subtheater area.

Environment: Students plan operations for forces, the simulation runs in a "batch" mode, and students are given results.

Force Composition: Strategic and tactical air and naval forces.

Scope of Conflict: Subtheater war.

Mission Area: Arrow plays the following missions: ANTINAVAL, AI, BAI, CAS, OCA, DCA, ECM, FAC, SEAD, RECCE, AIRLIFT, CONVOY, and SOF. CONVOY and AIRLIFT are the logistics missions.

Level of Detail of Processes and Entities: ACC, Tactical Air Control Center, and WOC levels.

CONSTRUCTION:
Human Participation: Required for ground combat, naval combat, and analysis.

Time Processing: The simulation executes in about 30 minutes.

Treatment of Randomness: Deterministic simulation for combat attrition.

Sidedness: Multisided. Playing teams are assigned in the data base.

LIMITATIONS: Ground forces and Naval forces are not automated.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Players perform inputs to four screens. The ATO screen allows players to plan combat sorties. The AIRLIFT screen allows players to plan air logistics. The CONVOY screen allows players to plan ground logistics. The SOF screen allows players to plan employment of special operations forces.

OUTPUT: Players are provided with combat results through two means: reports and graphics.

HARDWARE AND SOFTWARE:

Computer (OS): Sun 386i network running Sun OS 4.0.2 or higher; 16 megabytes of random access memory, and 320 megabytes disk drive per machine. It also runs on a similarly sized standard IBM 386 PC running under UNIX.

Storage: Requires 30 megabytes for software (source and executable) resident on the Sun 386i (not including commercial off-the-shelf software).

Peripherals: Uses 14-inch color monitors with 1152 x 900 pixel resolution and laser printers for Suns.

Language: C (using X11 Motif libraries), ORACLE relational data base management system (including SQL*Forms, SQL*ReportWriter, SQL*Plus, Pro*C), and UNIX shell scripts(csh).

Documentation: Functional Description, Maintenance Manuals, Operations Manual, and Game Books.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: About 1 man-week to rebuild data base. Extensive tools exist in the game to modify and build the data base.

CPU time per Cycle: Not applicable.

Data Output Analysis: Hardcopy via line printer and on-screen graphic displays.

Frequency of Use: As required. Not firm schedule.

Comments: Managed through review and configuration control board at the AFWC.

TITLE: ARTBASS - Army Training Battle Simulator System.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Combined Arms Command-Training, ATTN: ATZL-CTS-BB, Ft. Leavenworth, KS 66027-7301.

POINT OF CONTACT: SFC Rameriez, (913) 684-3189/3395, AV 552-3189/3395.

PURPOSE: Through use of a real-time battle simulation and a computer graphics display system, a battalion commander and staff may exercise the command and control realities that they will encounter on the modern battlefield. ARTBASS permits a battalion commander to observe the staff responding to input normally received from subordinate units in a tactical situation. It allows for alternate courses of action to be evaluated for effectiveness while stimulating the warfighting and decision making process.

DESCRIPTION:

Domain: Combined arms AIRLAND battle.

Span: Company thru Brigade.

Environment: Digitized terrain, 25 meter resolution.

Force Composition: Red and Blue units of joint or combined forces depending on the data base.

Scope of Conflict: Conventional maneuver operations.

Mission Areas: Conventional maneuver battalion mission areas.

Level of Detail of Processes and Entities: Individual weapon or soldier.

CONSTRUCTION:

Human Participation: Human participation required for decisions.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Lanchester.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: Can play in any terrain after input terrain files are preprocessed. Can model up to 300 units.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Ongoing Post Development Software Support (PDSS).

INPUT: Order of battle, firing rates, kill probabilities, mobility, terrain, weather, specific unit orders, firing commands, and graphic overlays.

OUTPUT: Sides display of unit locations and battlefield control information. Real-time CRT output reports of unit battlefield activity. Summary listings over time describing status.

HARDWARE AND SOFTWARE:

Computer (OS): Perkin Elmer.
Storage: 12 MB RAM, 3x 450 MB operating storage.

Peripherals: 20-inch color graphics monitor; workstation (keyboard, video display terminal); printers; Bit Pad and Pen; multi-function keyboard (MFKB).
Language: FORTRAN 4.0.
Documentation: TM 11-6920-751-10-1; ST 25-55.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Processed on Perkin Elmer 3200 CPU from hard disk storage device and/or tape drive backup devices.

CPU time per Cycle: Real time, 60 seconds per minute.

Data Output Analysis: Human, Realistic.

Frequency of Use: Weekly.

Users: Company/battalion/brigade. Nine systems fielded to Army Corps.

Comments: The features of the ARTBASS include its unique physical arrangement and its design as a fixed or mobile system which can be rapidly deployed and emplaced at existing Army facilities. It is composed of readily available commercial components and utilizes the using organization's field communications and field command post shelter equipment. Setting up the mobile training system is straightforward and can be accomplished in a short period of time. ARTBASS can be powered from either 110/220 AC power or from one of its two onboard organize 60KW diesel engines. These are fueled by its own 550 gal diesel tanks capable of sustaining three weeks of training operations. See attached for system configuration.

TITLE: ARTOAR - Attack Helicopter Air-to-Air Fire Control System Simulation Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Aviation Systems Command, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798.

POINT OF CONTACT: Daniel J. Breyer, (314) 263-1155, AV 693-1155.

PURPOSE: ARTOAR is used to evaluate attack helicopter fire control and turreted gun system effectiveness in one-on-one, nondueling air combat maneuvering engagements. The model deals with weapon systems development and effectiveness as they relate to helicopter aerial combat.

DESCRIPTION:

Domain: Air.

Span: Individual aircraft.

Environment: Flat earth, with no distinction between types of weather or time of day.

Force Composition: One firing and one target aircraft.

Scope of Conflict: Conventional guns only.

Mission Area: Air-to-air combat.

Level of Detail of Processes and Entities: Individual aircraft flight paths are represented by six degree-of-freedom trajectories. Sensors that feed target and ownership data to the fire control computer are simulated, as are the actual fire control algorithms to estimate target state, predicted impact points, and gun laying vectors. Bullet flyout is simulated by a four degree-of-freedom trajectory model, and probability of hit and kill per bullet are calculated.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Sensor readings and hit and kill calculations are stochastically based on Monte Carlo calculations.

Sidedness: Two-sided, symmetric, nonreactive.

LIMITATIONS: The model is specific to the sensors, guns, and fire control systems currently used on the AH-1S Cobra and AH-64A Apache attack helicopters. The data needed for other projectiles or advanced fire control sensors has not been developed or implemented. The aircraft flight paths are not based on helicopter or fixed-wing performance parameters, but are modeled simply as point masses.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improve the turret mechanism model, add new technology sensors such as muzzle velocity or closed loop fire control sensors, augment the projectile and target vulnerability data bases, and use true aerodynamic qualitics to simulate aircraft flight paths.

INPUT: Target and attacker flight paths, sensors and sensor accuracies, "real-world" ballistic data, physical gun characteristics, firing schedule, and fire control algorithms to be modeled.

OUTPUT: Computer printouts containing statistically analyzed probability of hit and kill data, raw data on target and ownship states, exact and measured sensor data, and plots of fire control algorithm accuracies in estimating target states.

HARDWARE AND SOFTWARE:

Computer:	IBM 4341/4381 using VM/CMS operating system.
Storage:	800 blocks (<1 MB) for the model (10,000 lines).
Peripherals:	Any computer terminal and printer can be used. Graphics are designed for a Tektronix 401x series terminal.
Language:	Model: FORTRAN 77. Graphics: PLOT 10.
Documentation:	A final report includes a user manual, an analyst manual, and methodology.

SECURITY CLASSIFICATION: Model is unclassified, and the only classified data base contains the target vulnerability data.

GENERAL DATA:

Data Base: Generally takes one analyst one to five days to produce a data base.

CPU time per Cycle: Depending on how many Monte Carlo iterations the user decides to run, 20 seconds of combat time can take from 1 minute (1 iteration) to 10 minutes (20 iterations).

Data Output Analysis: Model provides individual, burst, and cumulative burst probabilities of hit and kill, as well as aggregate statistics over all Monte Carlo iterations.

Frequency of Use: Varies by agency, but is used at least several times per year by each user listed below.

Users: U.S. Army Aviation Systems Command; U.S. Army Armament, Research, Development and Engineering Center; and U.S. Army Aviation Applied Technology Directorate.

Comments: ARTOAR was written to develop alternative fire control algorithms for turreted guns in helicopter versus helicopter aerial combat. Other targets modeled include fixed-wing aircraft and ground targets. A new version developed by Teledyne Systems Company includes 2.75-inch flechette warhead air-to-air rockets and associated fire control, ballistic, and kill computation coding for these.

TITLE: ASBAT - Air/Sea Battle Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Studies, Analyses, and Gaming Section (Code 64), Plans and Policy Division, CINCPACFLT, Pearl Harbor, HI 96860.

POINT OF CONTACT: Dr. Ray Runyan, (808) 474-8443.

PURPOSE: ASBAT is an analysis model used for assessing the effects of RED force attacks on BLUE carrier battle forces. It is a research and evaluation model that is used to assess force capability and requirements, particularly force mix within a carrier battle force and within attacking enemy forces.

DESCRIPTION:
Domain: Sea and air.

Span: Primarily local to the carrier battle force, with some regional activity also included.

Environment: Not considered explicitly. Environment may be reflected by choice of input values for some parameters.

Force Composition: BLUE carrier battle forces consist of a mixture of aircraft carriers, AEGIS cruisers, single-ended and double-ended missile ships (CGs, DDGs, and FFGs), ASW combatants (DDs and FFs), and auxiliaries. Aircraft assigned to the battle force include fighters, attack aircraft, and ASW aircraft, including helicopters. RED forces include surface ships, several classes of submarines, including both missile and torpedo shooters, and bombers, jammers, and escort aircraft.

Scope of Conflict: Conventional.

Mission Area: Sea control (AAW, ASW, ASUW).

Level of Detail of Processes and Entities: Ships, submarines, and aircraft are represented individually and suffer individual attrition. Ordnance expenditures are tailored on both sides.

CONSTRUCTION:
Human Participation: Required for input only. However, once assessment of a series of attacks starts, it may not be interrupted.

Time Processing: Dynamic, event-step for sequential RED attacks on BLUE. Individual ASW attacks are static, however AAW attacks are dynamic.

Treatment of Randomness: ASBAT is a Monte Carlo model.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Geography is not played explicitly, although relative distances are input. The model is essentially a RED-on-BLUE model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Will be modified to be compatible with THOR, a BLUE strike model, and CLEAR, a logistics resupply model. The trio will be named REJ, Real-Time Event Joiner.

INPUT: BLUE and RED orders of battle, sequence and structure of events, and performance characteristics (probabilities of detection, intercept, and kill, etc.; availability and reliability factors, parameters describing SAM launch cycles, etc.).

OUTPUT: Tables of average, 90th and 10th percentile results showing numbers of forces lost and ordnance expended for both RED and BLUE forces. Two levels of output detail are available: summary and expanded.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS systems or SUN UNIX.
Storage:	82 Kbytes (command file, executable, and typical data).
Peripherals:	Interactive terminal and optional printer.
Language:	FORTRAN 77.
Documentation:	(a) Center for Naval Analyses, A Sea Battle Model (U), CNR Research Contribution 373, April 1979, SECRET; (b) Ketron, Inc., Modification of SEABAT Program for CINCPACFLT's VAX 11/730 System, 21 November 1986, UNCLASSIFIED; and (c) Ketron, Inc., Status of the SEABAT Model on CINCPACFLT's VAX 11/730 System, 1 April 1988, UNCLASSIFIED; (d) CINCPACFLT Analysis Memorandum 3-90, Documentation of the ASBAT Model, 20 April 1990, SECRET.

SECURITY CLASSIFICATION: Unclassified (Secret with data files).

GENERAL DATA:

Data Base: Default data base provided with model. Time required depends on scope of modifications. Most modifications are made to force and attack structures and can be completed within minutes.

CPU time per Cycle: Seconds.

Data Output Analysis: Seconds.

Frequency of Use: Twice per week. CINCPACFLT uses ASBAT for its Annual Capabilities Assessment. ASBAT is also a supporting model for the cases module of the Fleet Command Center Battle Management Program (FCCBMP).

Users: CINCPACFLT.

Comments: ASBAT is derived from the SEABAT model, whose AAW subroutines were replaced with the AIRBAT model.

TITLE: ASCAM - ASW Campaign Assessment Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Studies Analyses and Gaming Section (Code 64), Plans and Policy Division, CINCPACFLT, Pearl Harbor, HI 96860.

POINT OF CONTACT: Dr. Ray Runyan, (808) 474-8443.

PURPOSE: ASCAM provides assessment of area ASW campaigns involving SSN, VP, and TAGOS assets against threat SSNs; accommodates randomly distributed threat submarines, or threat submarines operating in packs (FLUGS) with one SSN delousing the pack.

DESCRIPTION:
Domain: Sea and air.

Environment: Detection processes based on sweep width/search rate determination within environmental characteristics.

Force Composition: Blue VP/SSN/TAGOS vs. Red SSN/SSGN.

Scope of Conflict: Theater conventional ASW.

Level of Detail of Processes and Entities: Search assets randomly placed in defined operating area; threat submarines randomly placed or configured in packs; sweep and search rates adjusted for source level of pack configuration. Model determines state of each entity for each step (e.g., engaged, unengaged, attack, kill).

CONSTRUCTION:
Human Participation: None.

Time Processing: Determination based on environmental parameters and force configuration inputs and 24-hour, or other user defined, time-step.

Treatment of Randomness: States determined by transition probabilities and machine generated random numbers.

Sidedness: Two-sided, Blue vs. Red.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Scenario developed by defining ASW operating areas geographically and assigning Blue and Red forces to areas. There is no interaction between VP/SSN operating areas.

OUTPUT: Printout contains Blue/Red submarines remaining as a function of time.

HARDWARE AND SOFTWARE:
Computer: VAX/VMS.
Storage: 50 Kbytes.
Peripherals: Terminal and printer.
Language: FORTRAN 77.
Documentation: Center for Naval Analyses, Antisubmarine Campaign Model (U), CRM 86-125, May 1986, Secret.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Default data and user inputs. Time required depends on scope of user inputs; usually less than one hour.

CPU time per Cycle: Seconds.

Data Output Analysis: Seconds.

Frequency of Use: Several times per year.

Users: CINCPACFLT.

Comments: Useful model for assessing implications of Red forces operating in packs rather than randomly distributed in operating area.

TITLE: ASEM - ASAT Engagement Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Avtec Systems, Inc., 10530 Rosehaven St, Suite 300, Fairfax, VA 22030.

POINT OF CONTACT: T. Orndorff or C. Alexion, (703) 273-2211.

PURPOSE: ASEM simulates ASAT attacks on satellites. A scenario may contain multiple satellites and ASATs. The satellites perform evasive maneuvers and the ASATs respond with countermaneuvers.

DESCRIPTION:
Domain: Space and air.

Span: Global.

Environment: N/A.

Force Composition: As desired.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: All satellite orbits and ASAT trajectories are propagated using Runge-Kutta numerical integration. Satellite maneuvers are defined by acceleration vectors and associated durations. ASAT countermaneuvers are determined by either proportional or threshold navigation algorithms.

CONSTRUCTION:
Human Participation: Not required. Model is not interruptable.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, asymmetric, one side nonreactive.

LIMITATIONS: No practical limitations on number of satellites or ASATs.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Determin[illegible] of alterative ASAT launch vectors and times.

INPUT: Satellite orbits and maneuvers, ASAT launch vectors and times, and ASAT navigation algorithms.

OUTPUT: Satellite and ASAT positions, velocities, and line-of-sight vectors.

HARDWARE AND SOFTWARE:
Computer(OS): ANSI C compatible.
Storage: 100 K.
Peripherals: Printer.
Language: C.
Documentation: Light.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Up to several hours of preparation time for small scenarios.

CPU time per Cycle: Less than real elapsed time for small scenarios.

Data Output Analysis: N/A at present.

Frequency of Use: Several times per year.

Users: U.S. Air Force Space Division, U.S. Naval Research Laboratory.

TITLE: ASESS - Air Strike/Engagement Spread Sheet.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis but has been used as an exercise driver.

PROPONENT: Special Assistant for Operations Analysis, Deputy Chief of Staff, Operations, Pacific Air Forces, HQ PACAF/DOA, Hickam AFB, HI 96853-5001.

POINT OF CONTACT: Mr. Douglas Cook, (808) 449-6325, DSN (315) 449-6325.

PURPOSE: This is an attrition model that quickly examines changes in air defense force structures and effectiveness of large air strike packages.

DESCRIPTION:

Domain: Air and land, limited naval defensive operations.

Span: Accommodates any theater.

Environment: Unconstrained by distance or resources (not modeled). Effects of weather, night operations, warrior skill, technology must be incorporated into weapon system effectiveness factors.

Force Composition: BLUE and RED.

Scope of Conflict: Conventional warfare.

Mission Area: Air-to-air, offensive escort, defense suppression, airbase attack, defensive counter air, surface air defense, fleet combat air patrol, ship standoff attack, and close-in defense.

Level of Detail of Processes and Entities: Entities are aircraft, airbases, escort ships, carriers, squadrons, and carrier battle groups. Processes are squadrons of engagements that the user can turn on or off by setting a flag.

CONSTRUCTION:

Human Participation: Required if stragglers from raid group are to be chased by additional defenders.

Time Processing: Time, speed, and distance not a factor; engagements proceed in predetermined order.

Treatment of Randomness: Deterministic, expected value attrition.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: No geography, no limit on number of expected engagements or on ordnance expended. Suitable only where combat can be separated into sequence of separate engagements. Not suitable where air-based and surface-based defenses engage the attackers at the same time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Aircraft quantity, SAM rails, kill potential for various combinations of RED/BLUE engagements, and ship quantity. Typically, a dozen numbers are sufficient data to model an attack.

OUTPUT: Printout of spread sheet.

HARDWARE AND SOFTWARE:

Computer:	IBM PC/XT/AT compatible with MS-DOS V3.X. Also VAX 8650 with VMS 4.X.
Storage:	17 kilobytes of disk.
Peripherals:	1 dot matrix printer.
Language:	Enable V2.15, Lotus 1-2-3 (MS-DOS), 20/20 (VMS)
Documentation:	Model description (draft).

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Initial development can take up to 1 day. Changes take less than 10 minutes.

CPU time per Cycle: 1 second.

Data Output Analysis: Whatever graphics are supplied by the spreadsheet vendor.

Frequency of Use: Several times per hour during exercises/war games.

Users: HQ Pacific Air Forces/DOA, USCINCPAC/J55, Intelligence Center of the Pacific (IPAC/PT-3).

Comments: Integrated into USCINCPAC's Pacific Campaign Analysis Model (PACAMP). Modeled after spreadsheets developed by Carl Builder, Rand Corp.

TITLE: ASOAR - Achieving a System Operational Availability Requirement, Version 3.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Communications-Electronics Command, AMSEL-PL-SA, Ft. Monmouth, NJ 07703-5027.

POINT OF CONTACT: Mr. Bernard Price, AV 992-8752, Comm (908) 532-8752.

PURPOSE: Research and Evaluation Tool dealing with Weapon Systems in Systems Development and as an Operations Support Tool (Decision Aid). ASOAR cost effectively prorates a weapon system operational availability requirement to end item operational availability goals. It determines the degree of supportability necessary to achieve each operational availability goal. It also determines the effective reliability and maintainability of the system and effective reliability of redundant configurations.

DESCRIPTION:

Domain: Applicable to all weapon systems.

Span: N/A.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Weapon system operational availability, reliability analysis, and logistics supportability analysis.

Level of Detail of Processes and Entities: Primary End items and Government Furnished Equipment of weapon system is the lowest entity modeled.

CONSTRUCTION:

Human Participation: Required to determine configuration of the weapon system and its support concept.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Analyzes one weapon system at a time.

PLANNED IMPROVEMENT AND MODIFICATIONS: Development of Users Manual for Version 3.

INPUT:

- System Operational Availability.
- Reliability Block Configuration of end items.
- Mean Time to Obtain (MTTO) LRU spares.
- End item Mean Calendar Time Between Failure (MCTBF).
- End item Mean Restoral Time (MTR).
- End item cost estimate.

More inputs are requested if MTTO of LRUs are computed from supply and maintenance concept; scheduled maintenance/down time exists; multiple systems share forward level spares; or end item commonality or redundancy exists.

OUTPUT:

- Whether the system design and support plan can achieve the system operational availability requirement.
- System MCTBF and system MTR.
- Optimal operational availabilities for each end item.
- Effective MCTBF of each redundant configuration based on achieving its operational availability goal.
- Mean Logistics Down Time and LRU Order Fill Rate at the most forward supply level to achieve each availability goal.

HARDWARE AND SOFTWARE:

Computer:	Zenith PC (or compatible PC) with MS-DOS 3.2 or higher.
Storage:	300K bytes needed not including data base.
Peripherals:	Minimum Requirements; Monitor Optional; Printer.
Language:	Fortran IV.
Documentation:	ASOAR Model, AORS XXIX, page 53-56, Oct. 90; ASOAR Methodology, Jun 91; ASOAR Version 2 Users Manual, Dec 90.

SECURITY CLASSIFICATION: Model without data is unclassified.

GENERAL DATA:

Data Base: Can be prepared in minutes.

CPU time per Cycle: Not applicable.

Data OutPut Analysis: Analyst quality review of output appearing on monitor or printout.

Frequency of Use: Model distribution just started.

Users: Currently Army Communications-Electronics Command (CECOM).

Comments: ASOAR Version 3 will be completed and documented by Sep 91. Its executable code disk and documentation will be made available upon request.

TITLE: ASOSM - A Sub on Sub Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Naval Forces Division, Office of the Assistant Secretary of Defense (Program Analysis and Evaluation), The Pentagon, Room 2D312, Washington, DC 20301-1800.

POINT OF CONTACT: Mr. Nelson A. Jennings, (703) 695-1691, AV 225-1691.

PURPOSE: ASOSM is used to evaluate candidate submarines, sensors, and weapons in key antisubmarine mission roles.

DESCRIPTION:
Domain: Antisubmarine warfare.

Span: Designed for analysis of "one-on-one" submarine engagements.

Environment: Permits analyses based on ambient noise and propagation loss data for 20 ocean areas, summer and winter seasons, 3 receiver depths, and target depths. Long-term and short-term environmental effects are also modeled.

Force Composition: In one-on-one engagement, can model BLUE attacker versus RED defender, RED attacker versus BLUE defender, BLUE versus BLUE, etc. Can mix and match weapons and sensors in any way imaginable (e.g., a wide-aperture array on a RED sub).

Scope of Conflict: Primarily conventional warfare, but modeling nuclear weapons possible.

Mission Area: Supports analysis of following submarine missions: fixed barrier patrol, aided area search, unaided area search, transit area, and leave area.

Level of Detail of Processes and Entities: Fairly high degree of detail for submarines, sensors, and weapons. Processes are used to model submarine tactics, sensor performance, weapons use, boundary constraints, status display, and ocean noise fluctuations. Sonar equations modeled in detail.

CONSTRUCTION:
Human Participation: Required for scenario specification.

Time Processing: Event-step.

Treatment of Randomness: Starting positions of both subs are randomly arranged. Sonar detections are subject to random fluctuations Kill assessment is stochastic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Does not model anisotropic noise effects. Requires modification to handle many-on-many engagements.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Possibly expand mission roles modeled and permit analysis of many-on-many engagements.

INPUT: Secret data files for submarine self-noise, tactical speeds, sensor performance parameters, and weapons characteristics as well as ambient noise and propagation loss data.

OUTPUT: Graphical display of engagements as they progress, final report that summarizes model inputs (scenario) and results for all replications, and optional events summary and detections report.

HARDWARE AND SOFTWARE:

Computer:	IBM PC-XT compatible (preferably AT or 386) with DOS 2.0 or higher, math co-processor, 640K RAM, CGA graphics (preferably EGA or VGA), and 10 MB hard disk (preferably removable due to secret data bases).
Storage:	N/A.
Peripherals:	Printer (optional).
Language:	SIMSCRIPT II.5 with SIMANIMATION. SIMSCRIPT "run-time license" required to run the model, and "compiler" version needed to make modifications to the program.
Documentation:	A Sub on Sub Model (ASOSM) Analyst's Guide.

SECURITY CLASSIFICATION: Model is unclassified, but data is classified.

GENERAL DATA:

Data Base: 20 ambient noise and 40 propagation loss data files as well as numerous secret data files on submarines, sensors, and weapons.

Program: 3000-line SIMSCRIPT program.

CPU time per Cycle: N/A.

Run Time: About 1 hour for 50 replications with graphics display and 10 minutes without.

Data Output Analysis: Output reports providing summaries can be printed out or viewed on the screen with data editor.

Frequency of Use: Used several times per year.

Users: Naval Forces Division, OASD/PA&E.

Comments: Concept: Mr. Cheng Ling, OASD/PA&E. Design and Development: Mr. Nelson A. Jennings and Lt. Wayne DuBose, Operations Research and Modeling Branch, 7th Communications Group/GNP. Mr. Arthur W. Pennington, Director, Naval Forces Division, OASD/PA&E, guided ASOSM's final stages of development.

TITLE: ASUMS - Aircraft Survivability with Missiles and Stealth.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: WRDC, Avionics Laboratory, Analysis and Evaluation Branch (WRDC/AAWA), Wright-Patterson AFB, OH 45433-6543.

POINT OF CONTACT: Mr. William McQuay, (513) 255-2164.

PURPOSE: ASUMS is a research and evaluation tool that serves as a capability and requirements tool for few-on-few aircraft engagements. It assesses the value of different mixes of airborne weaponry, sensors, and tactics. ASUMS may also be used as a one-on-one engagement model. In this mode, results obtained from varying the aircraft, missile, sensor, or engagement characteristics may be used to determine input to campaign models.

DESCRIPTION:
Domain: Air.

Span: Local.

Environment: None specifically modeled.

Force Composition: Few-on-few aircraft engagements.

Scope of Conflict: Conventional.

Mission Area: Aircraft engagements.

Level of Detail of Processes and Entities: ASUMS models the flight path of the aircraft and air-to-air missiles and performs sensor tracking and battle planning functions. Because many of the characteristics describing the engagement are supplied by the user, ASUMS may be used to simulate air-to-air engagements involving several aircraft using radar or electro-optical sensors. Program flexibility allows the user to specify radar and IR lock-on range against opposing aircraft, visual detection and confirmation range, delay time before launch of second missile, acceleration limits on aircraft launching missile, and missile launch logic. ASUMS executes events from an event calendar. There are three basic types of events: real-world-update events, which carry out the engagement functions such as sensor tracking, battle planning, etc., and exogenous events, which are to be managed or controlled by the user outside of the program.

CONSTRUCTION:
Human Participation: Required for interactive input of visual range for each type of aircraft (required) and optional for changing state vectors for each aircraft.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, symmetric.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Aircraft, missile, and sensor characteristics; aircraft initialization; and aircraft maneuvers.

OUTPUT: Determines which aircraft launched which missile at another aircraft and whether a kill was accomplished.

HARDWARE AND SOFTWARE:

Computer: VAX 11/780.
Storage: 136,480 bytes.
Peripherals: Printer.
Language: FORTRAN IV.
Documentation: User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Typically 140.9 seconds.

Data Output Analysis: Manual analysis of tabular results.

Frequency of Use: Varies depending on requirements.

Users: Primarily WRDC/AAWA.

Comments: N/A.

TITLE: ASUMS II - Aircraft Survivability with Missiles and Stealth II.

DATE IMPLEMENTED: 1982.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The ASUMS II program is an event ordered simulation which models many variations of a multiple (few-on-few) aircraft engagement. The program models the flight path of the aircraft and Air-to-Air Missiles (AAMs) and performs sensor tracking and battle planning functions. Because many of the characteristics describing the engagement are supplied by the user, ASUMS II may be used to simulate air-to-air engagements involving several aircraft using radar and/or Electro-Optical (EO) sensors. Program flexibility allows the user to specify:

- Radar and Infrared (IR) lock-on range against opposing aircraft.
- Visual detection confirmation range.
- Delay time before launch of second missile.
- Acceleration limits on aircraft launching missile.
- Missile launch logic.

DESCRIPTION: ASUMS II executes events from an event calendar. The events are of three basic types: real-word-update events which move all aircraft and missiles: main-line-engagement events which carry out the engagement functions such as sensor tracking, battle planning, etc.; and exogenous events, which are events to be managed or controlled by the user external to the program.

Real-world-update events are controlled by the real-world driver and include positioning of all aircraft and all missiles; monitoring the position of all aircraft relative to all other aircraft; initiating the sensor tracking process when an aircraft enters the scan volume of another aircraft sensor; detonating the warhead when a missile reaches the point-of-closest-approach to its intended target; and evaluating damage to the target.

Mainline events include sensor measurements, track data filtering and maintenance of track status. Main-line-engagement events are associated with a specific "image" which relates to a specific sensor on a specific platform tracking a specific target. When "images" are initialized, they are processed as individual events.

Exogenous events are controlled by the user. These events include specifying the number and type of aircraft in the engagement and any subsequent aircraft maneuvers. When an aircraft is entered, its position, velocity, accelerations and body orientation are specified. Also the number of sensors and missiles on board are read from the data file at the time an exogenous event is processed.

The model allows some flexibility in reproducing a velocity history for a missile with a minimum of model complexity. Throughout a missile flight, the aerodynamic drag is modeled using a constant drag term consisting of the missile reference area, weight and drag coefficient, and the dynamic pressure calculated from the air density and missile speed.

Aircraft motion is described by constant accelerations and roll-pitch-yaw rates (which may be zero) input by the user.

The program checks scan volume of all surveillance sensors to determine when a threat is a candidate for detection. When a successful detection occurs, the sensor tracking process is initiated and the surveillance check is put on the event calendar.

As the missile position is updated, the time at the point-of-closest approach to the target is calculated. When this point is reached, the missile detonation logic is executed. At missile detonation, the Pk calculation is made and flags are set for "killed" aircraft.

<u>INPUT</u>: An input data file is written prior to execution, then assigned to a logical system input file. The input data file is in card image format and can be provided either from a card deck or a disk file. Some of the inputs needed from the user are:

- Number of aircraft, missile, and sensor types.
- Radar cross section.
- Limits for the aircraft.
- Maximum number of objects which can be tracked by a sensor at one time.
- Number of detections to establish track.

<u>OUTPUT</u>: <u>First Output Data File</u>: This is a summary matrix which is displayed on the screen. Each of the numbers in a cell are the number of aircraft of a certain type that survive the engagement. The first number in each cell corresponds to the first aircraft type in the input data, and the second number corresponds to the second aircraft type in the input data. At the end is a summary of the matrix giving the total number of aircraft of each type that survived and the total number of aircraft for all engagements. <u>Second Output Data File</u>: The program outputs provide the user with the information needed to evaluate the results of the simulation. All output begins with the current game time. ENTRY and MANUVR both end with x, y, z, v_x, v_y, v_z, roll, pitch, and yaw respectively. EST LOCK ON is the time of arrival of threat in engagement zone. RNG and R are the magnitude of relative position vector. Pk is the probability of kill. The summary output at the end gives which aircraft launched what missile at another aircraft, and if a kill was accomplished.

<u>HARDWARE AND SOFTWARE</u>:
- <u>Computer</u>: VAX 11/780.
- <u>Storage</u>: 210,106 bytes.
- <u>Language</u>: Fortran IV.
- <u>Documentation</u>: User's Manual.

<u>SECURITY CLASSIFICATION</u>: Source Code is Unclassified.

<u>GENERAL DATE</u>:
<u>Time Requirements</u>: Compilation time: 49.36 seconds. Typical run time: 677 seconds.

<u>Users</u>: Mitre Corporation; SAIC.

TITLE: ATTACK Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Kenkel, DSN 224-4247 or Commercial (703) 694-4247.

PURPOSE: The ATTACK model is a research and evaluation tool used primarily to combine information about attrition, weapon effectiveness, target acquisition, aircraft parameters, weather, etc., in order to develop a series of measures of effectiveness for a weapon system alternative.

DESCRIPTION:

Domain: Land and air.

Span: Accommodates any theater depending on the data base. Primarily used in the European Theater.

Environment: Models day and night operations with seasonal considerations and user-provided weather conditions.

Force Composition: Single- or multi-ship flight of BLUE air-to-surface aircraft (identical aircraft only) in a RED threat environment.

Scope of Conflict: Conventional warfare; air-to-surface missions.

Mission Area: Conventional fighter aircraft on air-to-air missions.

Level of Detail of Processes and Entities: Can determine the relative effectiveness of different BLUE aircraft (one or more aircraft within a single flight) versus a given RED ground/air threat.

CONSTRUCTION:

Human Participation: Required for decisions and processes. All data input accomplished prior to each execution of the model.

Time Processing: Dynamic time- and event-stepped.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: Does not model force packaging.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Attrition rates, sortie generations, en route and terminal area surface-to-air and air-to-air threats, target acquisition capability, weapons effects, battle-damage ratios, aircraft-specific parameters (sortie lengths, configurations, supply, turn times, etc.), weather, sensors, RED aircraft encounter rates, weapon effectiveness, and logistics. With the availability of cost data, the relative cost effectiveness can also be determined.

OUTPUT: Computer printouts with daily, seasonal, cost, and overall campaign effectiveness summaries (targets killed, aircraft lost, etc.).

HARDWARE AND SOFTWARE:

Computer:	Designed to run on any FORTRAN-capable machine.
Storage:	30-35K RAM for each data input set; 3-10K for each output file.
Peripherals:	Terminal and printer.
Language:	FORTRAN.
Documentation:	No documentation available.

SECURITY CLASSIFICATION: Unclassified (without data base).

GENERAL DATA:

Data Base: Several man-days to several man-months, depending on size of effort.

CPU time per Cycle: 4-5 seconds.

Data Output Analysis: None.

Frequency of Use: Varies with user. Several times a month within AFSAA/SAG.

Users: AFSAA/SAG, TAC/XP-JSG.

Comments: The ATTACK Model is an in-house model and is not available for distribution.

TITLE: AURA - Army Unit Resiliency Analysis.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis and training.

PROPONENT: Ballistic Research Laboratory, Vulnerability/Lethality Division, Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: Stephanie Juarascio, (301) 278-6341, DSN 298-6341.

PURPOSE: The AURA model may be used both as a research and evaluation tool and an operation support tool. Its primary outputs consist of personnel and equipment losses, identification of weak links within the unit structure, and unit effectiveness. As a research and evaluation tool it has been used extensively to study the effectiveness of weapon systems against targets and could be applied to the problem of assessing the most efficient mix of munitions types against particular targets. It has also been used as a tool to assess the impact of TO&E force structure changes on a unit effectiveness. It provides the flexibility to model the effects of cross-training and the various methods of task accomplishment which make it applicable for use in resource planning. As an operations support tool, the model has been used to generate casualty assessments in support of field operations. The model has also been used to provide information for field training exercises to drive the synchronization of replacement support decisions.

DESCRIPTION:

Domain: Land.

Span: Local.

Environment: Models temperature, humidity, wind speed and wind direction.

Force Composition: Unit level through battalion level and indirect fire.

Scope of Conflict: Conventional, nuclear, chemical, both RED and BLUE sides.

Mission Area: Indirect artillery, bombs, rockets, missiles, and smart munitions.

Level of Detail of Processes and Entities: Individual soldiers and equipment.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step and event-step. Progresses through events at user-specified times.

Treatment of Randomness: Optional basically deterministic and stochastic modes (Monte-Carlo simulation) for the treatment of deployment and conventional lethality. Monte Carlo treatment of randomness associated with distribution of rounds on target.

Sidedness: One-sided.

LIMITATIONS: No geography.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model is currently being modified to include the effects of smart munitions. Some consideration is being given to the inclusion of certain direct fire munitions, such as incendiary weapons.

INPUT/OUTPUT: Deployment of personnel and equipment, weapon characteristics, and unit operations.

HARDWARE AND SOFTWARE:

Computer:	CDC,DEC,VAX,IBM and CRAY.
Storage:	12 MB.
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	Includes but is not limited to:

1) Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 2: AURA Source Code, BRL-TR-3103.

2) Programmer/Analyst Guide for the Army Unit Resiliency Analysis (AURA) Computer Simulation Model, Volume 1: AURA Methodology, BRL-TR-3156.

3) Input Manual for the Army Unit Resiliancy Analysis (AURA) Computer Simulation Model: 1990 Update, BRL-TR-3187.

4) The Army Unit Resiliency Analysis (AURA) Computer Simulation Model: A Brief Overview, BRL-MR-3892.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data base: 3 man-months.

CPU time per Cycle: 10 to 20 seconds.

Data Output Analysis: Depends upon user-specified output options.

Frequency of Use: Daily.

Users: BRL, SAIC, TRAC-WSMR, TRAC-FLVN.

Comments: Model output supports chemical casualty estimates for the TRADOC Decision Support System (DSS), and field manuals. Has been examined for linkage to FORCEM and VIC.

TITLE: AWB - The Analyst's WorkBench.

DATE IMPLEMENTED: July 1991.

MODEL TYPE: Analysis; however, we are exploring training aspects also.

PROPONENT: Commander, Naval Weapons Center, (Attn: AWB Project Leader), Warfare Analysis Program (Code 304), China Lake, CA 93555.

POINT OF CONTACT: Ron Ketcham, AV 437-3263; Comm (619) 939-2363.

PURPOSE: The AWB is currently aimed at the Strike, War at Sea, and Air-to-Air warfare areas. Users can also develop models to attach to the AWB framework for other warfare areas. It can be used to evaluate effectiveness issues for tactics, weapon systems, or platforms, from a one-on-one to many-on-many situations.

DESCRIPTION:
Domain: Naval surface and air operations. Air operation are over sea and land.

Span: Theater.

Environment: DMA terrain and ADRG charts can be accessed.

Force Composition: Joint and combined forces, Blue, Red, Neutral.

Scope of Conflict: Currently conventional warfare. Other areas are being considered.

Mission Area: AAW, ASuW, Strike.

Level of Detail of Processes and Entities: AWB is a framework for linking a wide variety of models. These models have different levels of detail. Sophistication of models is dependent on user requirements and availability.

CONSTRUCTION:
Human Participation: Current version is user interactive. User makes all key decisions. AWB adheres to standard Macintosh Human Interface Guidelines for a logical and intuitive interface.

Time Processing: Varies dramatically, depending on models applied. Most fall within human reaction time.

Treatment of Randomness: Models attached to the AWB can be stochastic or deterministic.

Sidedness: Current version allows single user to control both red and blue assets. In some cases, the user can play one side against a scripted opponent. In this situation, the opponent is nonreactive. Future version will allow multiple players.

LIMITATIONS: Limitations are primarily due to current suite of attachable models. We have found that models can be modified, or added that meets new requirements.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional and more sophisticated models as projects demand. Multi-Player AWB. Interactive Scenario Setup Program. Monte Carlo Mode. Enhanced replay capabilities. Postprocessor to enhance output.

INPUT: Script files for scenario descriptions and run setups. Model and platform data files which define systems.

OUTPUT: Graphical and text output. Can be interactively "cut and pasted" into a variety of documentation software available on the Macintosh.

HARDWARE AND SOFTWARE:

Computer:	Macintosh Computer with Co-processor and 4 MB Ram. (8 MB RAM required if DMA data is accessed). Color monitor recommended.
Storage:	User has various options, from floppies to removable hard disks.
Peripherals:	Laser Printer. Color printer is nice, but not required.
Language:	PASCAL.
Documentation:	Users manual for input script files and operation. A Programmer's manual will be released in FY92.

SECURITY CLASSIFICATION: Model is unclassified; however, data may be classified.

GENERAL DATA:

Date Base: Built up over time. User Group is being established to share data and models.

CPU time per Cycle: Runs on dedicated CPU. Work sessions can be as long as user desires.

Data Output Analysis:

Frequency of Use: As needed.

Users: Analysts at several Navy Labs and fleet operators. Possible use by other services is being explored.

Comments: The AWB started out as a flexible framework for operations research analysts to use. However, we have found that there are many applications for this software, including:

- Analysis of tactics, platforms, and systems.
- Training and education.
- Extensions to other large models and wargame facilities.
- Exercise Reconstruction and evaluation.
- Mission Gaming.

TITLE: AWM - Amphibious Warfare Model.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis.

PROPONENT: Center for Naval Analyses, 4401 Ford Avenue, P.O. Box 16268, Alexandria, VA 22302-0268.

POINT OF CONTACT: Dr. George Akst, AV 289-2638, (703) 824-2186.

PURPOSE: AWM is a computerized model of conventional amphibious operations and is used as an analytical tool to evaluate weapons, forces, and strategies. Since its inception, the model has been used to compare alternative weapon systems, force structures, and amphibious assault concepts.

DESCRIPTION:
Domain: Land and air; partial naval support.

Span: Accommodates any regional area depending on data base; several data bases completed and others underway.

Environment: Terrain accommodated, but not in great detail; trafficability and visibility are considered. Also accommodates sea and surf for ship-to-shore movement. Does not directly model weather, time of day, or roads and barriers.

Force Composition: N/A.

Scope of Conflict: Conventional warfare only.

Mission Area: All aspects of amphibious warfare, including advance force operations, cruise missile attack and defense, ship-to-shore movement, assault landing, helicopter-borne operations, ground combat between maneuver units, artillery and naval gunfire support, tactical aircraft missions, and mine warfare.

Level of Detail of Processes and Entities: Handles levels from battalions to multiple divisions, with resolution down to the individual weapon system. The model was originally designed to handle MEF-sized operations. Many of the attrition processes are modelled using Lanchester equations, although a variety of other standard attrition models are used. Events are controlled by programmed tactical decision rules.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Time-step simulation using 1-hour intervals for the first 12 hours and 6-hour intervals thereafter.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Battlefield limited to eight sectors with eight battalion areas each, and a limited number of types of weapons (e.g., nine maneuver, six artillery, three surface-to-air missiles, and seven fixed-wing aircraft). Except for fixed wing aircraft, no forces can cross sector boundaries.

PLANNED IMPROVEMENTS AND MODIFICATIONS: More detail in artillery logistics.

INPUT: Terrain map including near-shore hydrography, orders of battle, attrition rates, fractional damage, kill probabilities, supply consumption data, landing plans, sortie rates, landing craft, and helicopter characteristics.

OUTPUT: Computer printout of casualties and surviving forces, both cumulative and for each model period; killer-victim scoreboards; and a summary table showing FLOT movement, survivors, and force ratios.

HARDWARE AND SOFTWARE:

Computer: Designed to run a VAX computer with a VMS operating system.

Storage: Executable image plus base totals 1,000 blocks. Source and object codes add about another 2,000 blocks. Output files vary depending on scenario.

Peripherals: Printer.

Language: FORTRAN 77.

Documentation: Model Overview (AD B0358261), Programmer's Guide (AD-B035784L), Description of Data Base (AD-C017556), Input Guide.

SECURITY CLASSIFICATION: Unclassified, but detailed description of data base is Secret.

GENERAL DATA:

Data Base: Depending on detail required, data bases can take from one to six man-months.

CPU time per Cycle: Depends on scenario and type of VAX computer; average size data base on VAX 11/785 can process each model period in about 15 seconds.

Data Output Analysis: Summary tables provided.

Frequency of Use: Sporadic, from one to several times per year.

Users: CENA, PACOM, PACFLT.

Comments: None.

TITLE: AWSIM - Air Warfare Simulation.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: Maj. Ed Poniatowski, (49) 631-536-6507, DSN 489-6507.

PURPOSE: AWSIM is designed to help train senior NATO commanders and their battle staffs in the execution of wartime general defense plans that emphasize joint and combined operations. The model is used for team skills development and as a nonscripted command post exercise driver.

DESCRIPTION:

Domain: Land and air, with limited naval operations.

Span: Theater.

Environment: Latitude- and longitude-based. Models day and night operations limited weather. Cultural features modeled include: rivers, sovereign boundaries, airbases, SAMs, SHORADs, ships, and radar sites.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional warfare. Simulation can include virtually all air conventional weapons and surface-to-air weapons.

Mission Area: All air warfare conventional missions.

Level of Detail of Processes and Entities: Can issue orders to flights of aircraft. Results include single aircraft kills. Munitions and fuel consumption are modeled with high resolution.

CONSTRUCTION:

Human Participation: Required for decisions and tasking.

Time Processing: Dynamic, time-step. Progresses through the scenario at an umpire-specified ratio of exercise time to real time.

Treatment of Randomness: Air attrition stochastically based on probability of kills as compared to a uniformly generated random number. Ground damage is modeled as "down time" for the attacked unit.

Sidedness: A three-sided (RED, BLUE, and CONTROL), symmetric, reactive model.

LIMITATIONS: Limited altitude play. Six altitude bands for SAM probability of kills. Altitude differential between airborne assets determines probability of kill. No terrain modeling.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Ongoing efforts to improve real-time performance and simulation fidelity.

HARDWARE AND SOFTWARE:

Computer:	Hosted on a VAX computer with VMS 5.4 operating system.
Storage:	Two MB.
Peripherals:	Minimum requirements: 4 VT100-type terminals, 2 Tektronics 4125-byte graphics terminals. Can also drive SUN and VAX2000, 3100 and 5000 workstations.

Language: RATFOR, FORTRAN, and "C".
Documentation: Player handbook, operator handbook, and extensive online and developmental documentation.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:
CPU time per Cycle: Depends on data base size and player configuration.

Data Output Analysis: Performed off-line by WPC Analysis Division using normal simulation outputs.

Frequency of Use: Up to 12 times a year depending on the WPC's exercise schedule.

Users: All NATO military commands.

Comments: AWSIM has a two-way automated link to the WPC's ground model (GRWSIM) to simulate the air/land battle. Air-to-ground combat and ground damage are passed to GRWSIM, and position and status data are passed back. The AWSIM model is also linked to the WPC's communications simulation. Normal game outputs are passed to the communications suite for "real-world" report formatting and distribution.

TITLE: Balboa.

DATE IMPLEMENTED: December 1990

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: Balboa is a Tactical Air Control Center (TACC) level model designed to illustrate Air Force doctrine and missions, principles of war, the tactical air control system, and force employment.

DESCRIPTION: During the planning phase of Balboa, the students deploy forces, munitions, and fuel to forward bases in Columbia and plan the offensive and defensive missions and strategies. The real-time execution phase models about 3 hours of an air-to-air and air-to-ground campaign.

Domain: Air operations against land and air targets.

Span: Location is in Columbia and Venezuela and Howard AFB in Panama.

Environment: Balboa models the preplanned missions prior to the start of execution day, and a 3-hour real-time campaign to gain air superiority and control of ground forces.

Force Composition: Air assets and ground-to-air missiles.

Scope of Conflict: Conventional warfare only.

Mission Area: Conventional mission including reconnaissance, air defense, air offense, close air support, and interdiction.

Level of Detail of Processes and Entities: TACC level.

CONSTRUCTION:
Human Participation: Required for processes and decisions.

Time Responses: Dynamic, real-time model.

Treatment of Randomness: Stochastic, attrition and targeting based on Monte Carlo determination.

Sidedness: Two-sided with the computer playing the side of the opposition.

LIMITATIONS:

PLANNED IMPROVEMENTS AND MODIFICATIONS:

INPUT: Students allocate certain aircraft to the defensive and offensive role, beddown all aircraft, plan the various types of missions, and activate airlift of munitions, support, and fuel during the planning session. During execution, the students respond to enemy tracks and message requested close air support and search and rescue.

OUTPUT: Balboa produces a printed record of all significant events during execution. Numerous printed and screen reports are available throughout the exercise.

HARDWARE AND SOFTWARE:

Computer(OS): IBM-compatible MS-DOS machine with hard-disk drive storage and 640 kilobytes random access memory. Balboa also requires a printer and a color monitor.

Storage: 1.0 megabyte for executable and 2.0 megabytes for disk work space.

Peripherals: Printer and color monitor.

Language: Turbo Pascal.

Documentation: User manual available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Requires about 2 man-weeks to key in new data base.

Data Base: Requires about 100 kilobytes.

CPU time per Cycle: Not applicable.

Data Output Analysis: Balboa includes a monitor program which allows for hardcopy analysis of data.

Frequency of Use: Used five times per year by the Squadron Officer School (SOS).

Users: SOS.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: BALFRAM - Balanced Force Requirements Analysis Methodology.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: USCINCPAC Staff (J55), Box 15, Camp H.Y. Smith, HI 96861-5025.

POINT OF CONTACT: Mr. Karl Eulenstein, (808) 477-0885, AV (315) 477-0885.

PURPOSE: BALFRAM is a research and evaluation tool used to simulate joint warfare. Because BALFRAM is a highly flexible model, applications are largely user-designed, allowing it to deal with weapon systems effectiveness, force capability and requirements, and combat development issues.

DESCRIPTION: It provides 10 mathematical formulations of attrition plus Lanchester square, linear, and mixed differential equations with variable coefficients. The user sets the size of the time steps. The model is abstract enough that virtually all environments and types of conflict can be accommodated through user definition.

Domain: Air, land, sea, and combined.

Span: Local, regional, theater, or global (user-defined).

Environment: Not explicitly considered. The user must integrate all environmental factors into the mathematical formulations or data.

Force Composition: All types.

Scope of Conflict: Conventional, nuclear, biological, chemical, or any combination of these.

Mission Area: User-defined.

Level of Detail of Processes and Entities: User-defined.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Either basically deterministic or stochastic (Monte Carlo); it is user-selectable.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Fixed numbers of battle units and battle nodes, which can be changed by source code modifications.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model is being revised to decrease size, increase run speed, simplify output, add graphics, and improve overall efficiency.

INPUT: Scenario geography, network structure, interacting entities, relative effectiveness coefficients, contingency logic, movement rates and logic, selection of mathematical attrition formulas, output, time-step, and functional relationship between unit/force effectiveness and logistics availability.

OUTPUT: Battle history printouts in user-selectable level of detail and frequency; sensitivity analysis matrices in deterministic and stochastic form; statistics such as means, variances, and confidence intervals.

HARDWARE AND SOFTWARE:

Computer:	Runs on any MS-DOS, VAX, or WWMCCC, Honeywell system.
Storage:	No less than 256 Kbytes.
Peripherals:	Interactive terminal and wide-carriage printer.
Language:	FORTRAN IV (being revised to FORTRAN 77).
Documentation:	Honeywell maintenance manual, user manual, and a somewhat simplistic and dated tutorial guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: User-supplied; typically takes one to two man-months to prepare.

CPU time per Cycle: Depends on machine and simulation size; on the order of minutes for a theater-level, deterministic simulation of a single region, run on a Compaq 386/16. For stochastic runs, multiply the deterministic run time by the number of iterations.

Data Output Analysis: Minutes.

Frequency of Use: Not in use while being revised. In its heyday, it was used about twice per year.

Users: USCINCPAC.

Comments: N/A.

TITLE: BASEWAM - Battlefield Surveillance Electronic Warfare Analysis Model.

DATE IMPLEMENTED: 1982 (Updates through 1991).

MODEL TYPE: Analysis.

PROPONENT: Electronics and Space Corp., (E&S Corp.), 8100 W. Florissant, St., Louis, MO 63136.

POINT OF CONTACT: Gus Zenker, 314-553-4635, (FAX) 314-553-4750.

PURPOSE: BASEWAM is a research and evaluation tool used to analyze ground and airborne target acquisition, surveillance, electronic warfare (EW) and command, control and communications (C^3) systems and processes in realistic countermeasures environments. Because of its ability to simulate complete division/corps-sized systems to the individual component/platform level, BASEWAM is unique in its ability to determine total system requirements as well as to measure system vulnerability, performance and effectiveness.

DESCRIPTION:

Domain: Land, air.

Span: Regional, up to corps vs. army-sized area of operation.

Environment: Digitized terrain; weather effects played implicitly through sensor and platform performance; high resolution simulation of the electronic battlefield.

Force Composition: Can be tailored to the individual study. Typically, sensor and EW systems, C^3 links and nodes, and countermeasure systems are depicted at the system/platform/element level for both Red and Blue. Target arrays may include a combination of individual and aggregated target elements.

Scope of Conflict: Conventional, with associated fire support. May be specialized to concentrate on air defense. Emphasis on electronic battlefield considerations.

Mission Area: Air Defense; Reconnaissance, Surveillance and Target Acquisition (RSTA); Intelligence/Electronic Warfare (IEW); C^3; Fire Support.

Level of Detail of Processes and Entities: High resolution, explicit simulation of sensor, EW, C^3, fire support/countermeasure system/subsystem entities and operations. The processes of target acquisition, target processing, C^3, and the active and passive countermeasures to these processes are all explicitly simulated. The effects of terrain conditions on radio frequency wave propagation and line-of-sight are played for all sensors, communications links, electronic support measures (ESM) and countermeasures (ECM).

CONSTRUCTION:

Human Participation: Not required or permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic, expected value.

Sidedness: Two-sided, symmetric but may be run in an asymmetric mode with either or both sides reactive.

LIMITATIONS: Target arrays are scripted.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of air defense engagement module.

INPUT: Digitized terrain, organizations/nodes and scheme of maneuver for systems to be explicitly represented, detailed performance of systems and subsystems played, scripted target array.

OUTPUT: Computer printouts with statistical analysis as desired.

HARDWARE AND SOFTWARE:

Computer(OS): VAX 11/780 (VMS 5.3) or VAX Station 3100 Model 40 (VMS 5.3).
Storage: Source - 33,000 blocks, data/output- 75,000 blocks.
Peripherals: Printer, graphics workstation/terminal.
Language: VAX FORTRAN V. 5.4.
Documentation: Available, but not published.

SECURITY CLASSIFICATION: Unclassified; data typically classified.

GENERAL DATA:

Data Base: Man-weeks to man-months depending on scope and availability of scenario and numbers and types of systems played.

CPU time per Cycle: 10-15 hours with postprocessing for typical division-level scenario of 6 hours duration.

Data Output Analysis: Hours to man-weeks depending on research issues.

Frequency of Use: Two or more major studies per year.

Users: E&S Corp., U.S. Army Air Defense School, Vulnerability Assessment Laboratory.

Comments: BASEWAM is proprietary software owned by the E&S Corp.

TITLE: BATMAN & ROBIN - Friendly Interfaces for Performance Measurement.

DATE IMPLEMENTED:

MODEL TYPE: Decision Support System.

PROPONENT: Department of the Navy.

POINT OF CONTACT: Dr. Pat-Anthony Federico, Navy Personnel Research and Development Center (NPRDC), Code 15, San Diego, CA 92152-6800. Commercial (619) 553-7777; AV 553-7777; FAX: 619-553-0477.

DESCRIPTION:

A. Overview: BATMAN (Battle-Management Assessment system) is being developed to assess how well individuals can allocate, deploy, and manage air, surface, and/or subsurface tactical assets during simulated sea battles in many warfare areas. ROBIN (Raid Originator Bogie Ingress) is being developed to rapidly generate Red force raids comprised of a large number of air, surface, and/or subsurface tactical assets against Blue naval task forces or land bases in many warfare theaters. In order to complete the creation of a scenario, the user also specifies in ROBIN Blue force tactical resources that will be available in BATMAN for allocation, deployment, and management as well as Green or neutral force air, surface, and/or subsurface movements. Together BATMAN & ROBIN form a desk-top, computer-based, performance-measurement system incorporating high resolution graphics, low level modeling, and artificial intelligence techniques to fill the gap between board games that are run in real or fictitious time with subjective assessment and inappropriate feedback and very expensive and man-hour-intensive, mainframe-based simulators. Two of the major contributions of these dual systems are very friendly human-computer interfaces and automated performance measurement.

B. Appropriate Uses: Because of the nature of their generic software and independent data bases, as well as the potential for incorporating different computer models, BATMAN & ROBIN can be used for a variety of functions 1) training and testing tactical knowledge, 2) planning and decision aiding for tactical situations, 3) developing and evaluating tactics themselves, 4) analyzing and evaluating various tactical sensor, weapon, and communication systems, 5) frontending sophisticated tactical computer models and complex data bases, 6) interfacing tactical artificial intelligent and expert systems, 7) generating rapidly scenarios for tactical trainers, 8) prototyping complicated scenarios for major wargaming systems, 9) orienting novices to facets of naval warfare, 10) evaluating tactical display symbologies and formats, and 11) providing an experimental environment for studying tactical decision making.

C. Equipment Required For Use: BATMAN & ROBIN are written in the "C" programming language and run on the SUN-4 family of computers; e.g., 110, 260C, 280S, Sparcstation 1, 2, 330, and 370, as well as the Navy's Desk-Top Tactical Computer (DTC) 2 under SUN Microsystems Release 4.1.1 of the UNIX operating systems. These systems are completely documented and properly commented to facilitate integration of various validated and verified computer models to these friendly human-computer interfaces.

D. Inputs Required for Use: ROBIN creates scenarios that can be saved, and subsequently presented sequentially or randomly in BATMAN. Also, ROBIN can be used as a rapid scenario generator independently of BATMAN; i.e., it can be adapted to front-end systems such as BFIT (Battle Force Inport Trainer), REAS (Research, Evaluation, Analysis System), as well as others. BATMAN & ROBIN use data bases which are independent of the simulation software to store the parameters, attributes, and characteristics of Blue, Red, and Green platforms.

Currently, these values are unclassified or sanitized; however, they can be made classified by using the friendly graphic interface.

E. Processing Techniques for Input: Since they present an animated, computer-based, simulated model, metaphor, or microworld to the user, BATMAN & ROBIN require direct-manipulation of icons or graphic objects on the computer screen by using a mouse. These systems assume that the operator has some knowledge of Blue, Red, and Green force platforms, sensors, weapons, and tactics.

F. Output Consists of: BATMAN assesses the tactical decision making of the individual managing the entire battle, or any of its components in terms of composite warfare structure, by measuring performance automatically and objectively against multivariate criteria which are immediately feedback to the user at the end of each scenario. These measures are saved by the system for subsequent statistical analyses, and are available for formative and summative evaluations of performance.

G. Use of Output: Output can be employed according to the uses specified in paragraph B. above.

REFERENCES: NPRDC TN 89-18 BATMAN & ROBIN: Rationale, Software Design, and Data base Descriptions; NPRDC TN 91-XX Human-Computer Interfaces for Tactical Decision Making, Analysis, and Assessment Using Artificially Intelligent Platforms: Volume 1, Software Design and Data Base Descriptions for BATMAN & ROBIN.

ALTERNATIVE APPROACHES: None are known at this time.

STAGE OF DEVELOPMENT: Direct-manipulation human-computer interfaces for electronic warfare, neutral or Green forces, and a relational data base for platform parameters have recently been added to BATMAN & ROBIN. Also, artificially intelligent or smart platform behavior have recently been incorporated into these systems.

HOW TO OBTAIN BATMAN & ROBIN: These systems will be provided to Department of Defense (DoD) organizations for specific research and development projects, if the commanding officer of the requesting agency, or someone comparable, signs a formal memorandum of agreement with the commanding officer NPRDC restricting the use of BATMAN & ROBIN. For example, these systems are not to be employed for tactical training and testing at this time The computer models and data bases currently used have not been validated or verified. The development has focused on creating the human-computer interfaces--not the computer models or data bases which are already widely available throughout DoD. Anyone interested in using these systems contact: Dr. Pat-Anthony Federico, NPRDC, Code 15, San Diego CA 92152-6800; (619) 553-7777; AV 553-7777. Strongly suggest that those interested call before preparing a written request.

COMMENTS: The generic nature of BATMAN & ROBIN allows the user to add or delete platforms at will without rewriting the software. Also, the modularity of the code permits the incorporation of different computer models for various sensor, weapon, communication, and environmental systems. The SUN-4 family of computers allows the running of models written in different languages simultaneously; e.g., "C", ADA, MODULA-2, FORTRAN 77, PASCAL, and COMMON LISP.

TITLE: BBS - Brigade/Battalion Battle Simulation.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education.

PROPONENT: Combined Arms Command-Training (CAC-TNG), National Simulation Center (NSC), Ft Leavenworth, KS 66027-7301.

POINT OF CONTACT: MAJ Lehnherr, (913) 684-3189, AV 552-3189.

PURPOSE: To provide battalion and brigade commanders and their staffs an environment to train in the execution of AIRLAND battle doctrine at the tactical level of war. BBS is used primarily as a Command Post Exercise (CPX) driver.

DESCRIPTION: BBS is a system of computers networked together to provide the driver for CPX or command staff training. The simulation operates as a two-sided, free play, real-time training environment. The system plays air and ground warfare between opposing units and the resupply, medical, and maintenance required to support the conflict. It is a high resolution model which represents weapon and support systems at the item level.

Domain: Land and air.

Span: Accommodates any 10,000 to 30,000 square kilometer land area. Several data bases are currently available, others have been proposed.

Environment: 100 m X 100 m square based. Models terrain relief for LOS and mobility, roads, rivers, barriers and built-up areas (cities). Models time of day and weather.

Force Composition: Army forces, Blue and Red.

Scope of Conflict: Conventional, nuclear and chemical warfare, both Blue and Red (mid and high intensity conflicts).

Mission Area: Conventional, nuclear and chemical Air Land missions.

Level of Detail of Processes and Entities: Nominally models down to Platoon level for Battalion CPX, down to company for Brigade CPX. Can model squads, single vehicles/soldiers and single aircraft for reconnaissance or other special missions, but model is more efficient for smaller number of units. Personnel modeled by MOS for each entity. Movement, conflict and Combat Damage Assessment (CDA) affect supplies, ammunition and POL levels for all entities. Communications and IEW affects on communications are also modeled.

CONSTRUCTION: Distributed processing among up to 10 Micro Vax computers; video disk technology for terrain representation; IEV graphic overlay of video displayed maps. Presently being replaced by Amiga graphic drivers. The simulation is a real-time, man-in-the-loop, free play system which responds to the desires of commanders in the field. Interface to the model is through controllers which play subordinate units, therefore making the simulation transparent to the training audience.

LIMITATIONS: Limited to play terrain types available as digitized data with video disk display.

PLANNED IMPROVEMENTS AND MODIFICATIONS: More terrain areas, Amiga graphics, multi-stations per Micro Vax.

INPUT: Movement/conflict orders, unit names/locations, resupply.

OUTPUT: Conflict resolution, battle damage, personnel and logistics losses, alerts, reports, graphic battle depiction.

HARDWARE AND SOFTWARE:
- Computer (OS): Digital Equipment VAX/VMS.
- Storage: 2 hard drives of 71 Meg each.
- Peripherals: Terminals, printers, TV, IEV graphics processor.
- Language: MODULA-2.
- Documentation: Under control for deliverable.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
- Data Base: 1 week.
- CPU time per Cycle: Interactive free play.
- Data Output Analysis: N/A.
- Frequency of Use: 160 times per year.
- Users: Battalion and brigade command and staff.

TITLE: BCOM - Battalion Combat Outcome Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis and Semi-Automated Forces Driver.

PROPONENT: BDM International, Inc., 2600 Garden Road, Monterey, CA 93940.

POINT OF CONTACT: Dr. Wm. Bruce Weaver, (408) 649-3880; Mr. Lew Henderson, (408) 649-3880.

PURPOSE: BCOM is used to evaluate vehicle, weapon, and force effectiveness for new hardware and tactics. Ii has also been used for training evaluation, force mix determination, and resource planning. It can play back NTC data in the same graphical format as computer generated battle displays. A three dimension display window permits the user a view from any vehicle or point in the battlefield. It can also use manned simulators or fielded equipment for vehicle inputs for any number of battlefield entities.

DESCRIPTION:

Domain: Land and air.

Span: Individual vehicle to Battalion. Can use any available digitized terrain.

Environment: Continuous resolution. Resolution-independent but typically uses 12.5 meter resolution digitized terrain for 2-D and lower but variable resolution for 3D displays. Cities, forests, relief, weather, and time of day are played. Intervisibility calculations have been validated with field tests.

Force Composition: Joint and combined forces, Red and Blue.

Scope of Conflict: Conventional, unconventional, and postulated weapons.

Mission Area: All land combat including attack helicopters.

Level of Detail of Processes and Entities: Typically, lowest level of detail is vehicle level but components (e.g., IR detection systems, low observable components) are sometimes included. Modular system implementation permits level of detail to be easily altered to fit problem. Attrition, movement, etc., are all modeled at the vehicle level. PATHFINDER, the scenario design program, deals with any unit level from vehicle to battalion; then it propagates the scenario to the vehicle level.

CONSTRUCTION:

Human Participation: Not required after scenario design; however human participation is permitted. Analytical applications typically run without human participation; training applications run both with and without human participation. When human interaction is used, the model does not wait for decisions.

Time Processing: BCOM is a dynamic time-stepped model. The time-step length is user specified and can be synchronized to real-time.

Treatment of Randomness: BCOM is a stochastic model using empirical probability distributions derived from Real-Time Casualty Assessment Experimentation employed primarily in a Monte Carlo format.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: No dynamic automatic mission planning. No dismounted infantry. No fixed wing aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Dynamic, automatic and manual, mission planning. Integration with SIMNET/CCTT as SAFOR Driver.

INPUT: Digitized terrain. P_k tables. Force mix. Special weapons characteristics.

OUTPUT: Time history of battles. Statistical analysis of weapons and force effectiveness.

HARDWARE AND SOFTWARE:

Computer(OS):	PC (limited version) with DOS. SUN (2-D display only) with UNIX. Silicon Graphics (includes 3-D windows) with UNIX.
Storage:	PC - 640 Kbytes. Workstation - A few megabytes depending on force mix.
Peripherals:	Mouse required for PATHFINDER. Some technique for importing terrain data.
Language:	FORTRAN and C.
Documentation:	Generally modest. Some user level and extensive in-line.

SECURITY CLASSIFICATION: Unclassified without P_k data bases. Unclassified P_k table available.

GENERAL DATA:

Data Base: Assuming available digitized terrain, data base takes a few hours to a few days to prepare.

CPU time per Cycle: Without 3-D graphics, about 20 battalion-level battles per hour. With 3-D graphics, about 3 battalion-level battles per hour. Real-time in real-time mode.

Data Output Analysis: Postprocessor generates force and vehicle statistics. Mines, smoke, etc., also analyzed. Limited graphical displays (time history of force drawdown). Detailed engagement data available.

Frequency of Use: 3-4 studies per year.

Users: C&GSC School of Advanced Military Studies; Army Research Institute (for NTC Playback); Los Alamos Advanced Technology Assessment Center.

Comments: Menu-driven set up. Preprocessor, PATHFINDER, performs extensive terrain analysis, intervisibility displays. 3-D examination of positions and avenues of approach is supported.

TITLE: BEST WEAPON.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: AD/XRP, Directorate of Plans and Integration, Elgin AFB, FL 32542-5000.

POINT OF CONTACT: Mr. Martel or Ms. Willis, (904) 882-4151.

PURPOSE: The purpose of the BEST WEAPON computer model and data base system is to provide analysis in support of the Armament Division Non-nuclear Armament Plan and the HQ AFSC Armament Mission Area Plan. The BEST WEAPON model and data base system assesses inventory, developmental, and conceptual non-nuclear munitions as part of total weapon system concepts.

DESCRIPTION:
Domain: Land and air.

Span: Theater.

Environment: Day, night, and weather; three theaters; and three time frames.

Force Composition: For each theater: 20 aircraft types, 58 weapons, 85 targets, and 60 avionic types (SAR, LANTIRN, etc.).

Scope of Conflict: Conventional, theater (no chemical warfare).

Mission Area: Defensive counterair, offensive counterair, lethal suppression of enemy air defense, air-to-surface fixed, and air-to-surface nonfixed.

Level of Detail of Processes and Entities: Entities: Single weapon, single aircraft, and single avionics package going against a single target. Processes: Calculates aircraft remaining, targets killed, and weapons expended using attrition and effectiveness data for each aircraft, weapon, avionic, and target combination.

CONSTRUCTION:
Human Participation: Required for data base preparation and initial case variables input. These variables are theater, year, mission area, mobility option, threat, and weapon candidates.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Deterministic, value generated as a function of expected value.

Sidedness: N/A.

LIMITATIONS: 20 aircraft, 58 weapons, 60 avionic, and 85 targets.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Data base management, air-to-air methodology, increase aircraft and weapon capability, target acquisition methodology, and capability to analyze mines.

INPUT: Aircraft, sortie rates, attrition drawdown, mission capability rates, weather frequency, payloads, number of passes, single pass expected kills, attrition, target acquisition, targets, and target/sortie allocation.

OUTPUT: Targets killed, aircraft remaining, and weapons expended.

HARDWARE AND SOFTWARE:
- Computer: VAX.
- Storage: 2,000 storage blocks for programs and 50,000 storage blocks for data.
- Peripherals: Printer.
- Language: FORTRAN 77.
- Documentation: Fully documented.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1 day to 6 months.

CPU time per Cycle: Varies depending on mission area.

Data Output Analysis: Ongoing.

Frequency of Use: Weekly.

Users: AD/XRP, Directorate of Plans and Integration.

Comments: None.

TITLE: BETA.

DATE IMPLEMENTED: 1981.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The purpose of the BETA program is to calculate the probability that a missile with a blast-fragmentation warhead will kill an aircraft target. The program determines whether a missile flying by an aircraft will fuse its warhead, and then calculates the effect projectiles from the warhead blast have on the target. The output is Probability of Kill (Pk).

DESCRIPTION: Three modes of trajectory generation are available to the user. In the random or Monte Carlo mode, guidance system errors are taken into account by calculating kill probabilities for many parallel but randomly distributed trajectories. In the parametric mode, the model generates many parallel missile trajectories uniformly distributed at a specified radial miss distance or in an elliptical distribution.

The program output can be used to plot curves of single-shot kill probability as a function of Circular Error Probability (CEP) and Pk versus miss distance. In the single-shot mode, components of miss distance are specified for each missile trajectory. This mode is suitable for simulator studies, i.e., calculating kill probabilities associated with individual missile trajectories.

The program calculates kill probabilities for several different warhead fusing-to-detonation delay times for each trajectory in any of the above modes. In addition, four different warhead fusing models are available in BETA. Thus, parametric studies can be conducted to determine the optimum fusing conditions.

The mathematical simulation is based on events which occur during the terminal phase of a missile-target interception. These events occur subsequent to the last moment at which the missile can make any change in flight path as a result of information received from its guidance system.

The target vehicle is represented in terms of a set of blast contours, within which missile detonation produces severe structural damage, and a configuration of critical components vulnerable to fragments and their structural masks. The probability of detonation within the blast contour and the probability that each vulnerable component has been hit by fragments are determined. A detonation within the appropriate blast contour is assumed to represent a certain target kill; i.e., the kill probability is 1.0. Vulnerable components struck by fragments are assumed to be destroyed fractionally. If a blast kill is not registered, vulnerable component kill probabilities are combined with each other, as required by the definition of the aircraft as a system, to determine the overall kill probability.

Constant velocities are assumed for both target and missile. The direction of approach of the missile toward the target is a parameter in the input data. The missile trajectory is parallel to a straight line designed the "perfect homing line".

BETA has three different modes: parametric, random, and single shot. In the parametric mode, the model generated a specified number of missile trajectories parallel to the perfect homing line and uniformly distributed about it at specific radial miss distances. The arithmetic average of the kill probabilities for all intercepts at a given radian miss distance is used as the value of kill probability for that distance.

In the random or Monte Carlo mode, guidance system errors are taken into account by assuming that all missile trajectories for a specified intercept geometry are parallel to the homing line and are distributed around it in a bivariate normal distribution (circular or elliptic).

In the single-shot mode, components of miss distance are specified for each missile trajectory. This mode of operation is suitable for use with simulator experiments to estimate the kill probability associated with individual missile detonations.

For each target vehicle, a scale drawing of the top, front, and side views is required. Measurements taken from these drawings constitute the bulk of computer inputs. Target points are categorized as:

- Fusing points which define the target vehicle surface,
- Masking points which define components having the ability to shield other components from fragment strikes, and
- Vulnerable points which belong to components whose performance is impaired by a fragment strike.

The warheads under consideration produce both blast and fragment kills. Detonation of the warhead within the aircraft blast envelope will bring about a blast kill, and overall defeat of the aircraft due to massive structural damage.

Fragment kills, on the other hand, are local in nature and pertain to aircraft components, such as pilots, engines, fuel, and electronic equipment. A fragment kill of a particular component occurs when the speed and striking angle of a fragment are favorable to penetration of the component. In the model, the fragments are assumed to travel in an expanding lethal band on the surface of an imaginary sphere.

The model employs a fixed-angle, fixed-cut-off range fuse. Fusing is assumed to occur at the earliest time of interception of the surface of the truncated, right circular cone (representing the range of fuse effectiveness) by a target point designated as a fusing point. If desired, up to 11 equally spaced delay times (and detonations) can be specified.

INPUT: BETA has four different input files depending on the operating mode:

- Target generation.
- Vulnerable area tables and probability formula.
- Blast contour.
- Case parameters.

OUTPUT: The program output consists of the input variables, the number of blast kills, and Pk tables for each of the components and the total Pk for the aircraft. There are Pk tables for each of the trajectories and detonation points and a Pk table for the average over the different detonation point cases.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	272,865 bytes.
Language:	FORTRAN IV.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:

Time Requirements*: Compilation time: 80.56 seconds; Typical run time: 2 minutes. *Actual compilation and run times will vary greatly depending on the complexity of the target description, the number of trajectories and detonation points to be computed, and so on. The times given above are for the simple, single trajectory and detonation run.

Users: DDM Corporation; Lockheed Aircraft Services; Loral Advanced Projects; SAIC; The Rand Corporation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: BICM - Battlefield Intelligence Collection Model.

DATE IMPLEMENTED: January 1989.

MODEL TYPE: Training and Education.

PROPONENT: U.S. Army Combined Arms Command-Training, ATTN: ATZL-CTB, Fort Leavenworth, KS 66027.

POINT OF CONTACT: LTC DeWitt, USACAC-TNG, Battle Command Training Program (BCTP), Fort Leavenworth, KS, AV 552-5461, COMM (913) 684-5461.

PURPOSE: To provide intelligence sensor reporting of the battlefield to the corps, division and brigade Tactical Operation Centers (TOCs). BICM uses the Corps Battle Simulation (CBS) battlefield as its input each time cycle. BICM provides the intelligence reporting for a CBS Corps or division command post exercise or BCTP warfighter exercise.

DESCRIPTION:

Domain: Air and land.

Span: Region through theater.

Environment: Terrain modeled in 3km hexes.

Force Composition: Joint forces.

Scope of Conflict: BICM only senses battlefield entities, there is no conflict modeled.

Mission Area: Intelligence command and control.

Level of Detail of Processes and Entities: Units are modeled to the individual sensor (i.e., airborne sensor, one individual-HUMINT, etc.).

CONSTRUCTION:

Human Participation: Man in the loop for sensor mission input and interpretation of sensor output.

Time Processing: Time-stepped at any desired length (usually 15-20 minutes).

Treatment of Randomness: Sensor characteristics are described with probabilities that are evaluated with random number draws.

Sidedness: Two-sided.

LIMITATIONS: Depends on CBS for battlefield situation. Intel controllers required.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Reports sent directly to TOCs.

INPUT: Interactive order input from controller staff.

OUTPUT: Printed sensor reports.

HARDWARE AND STORAGE:

Computer:	DEC MICROVAX II and two 150MB disks.
Storage:	N/A.
Peripherals:	Four VT330 terminals, one or more LA210 printers.
Language:	FORTRAN.
Documentation:	Operator manuals and programmer manuals.

SECURITY CLASSIFICATION: Unclassified - can be secret if the CBS exercise is secret.

GENERAL DATA:

Date Base: Battlefield data base is automatically extracted from the CBS data base. The sensor characteristic data base is interactively built in a day.

CPU time per Cycle: Time cycle is usually 20 minutes with 10 minutes CPU required to process.

Data Output Analysis: BICM holds all sensor reports in a data base that can be queried for analysis.

Frequency of Use: Used in every BCTP WFX (14 times per year).

Users: Battle Command Training Program, Fort Leavenworth, KS.

Comments:

TITLE: BLDM - Battalion Level Differential Model.

DATE IMPLEMENTED: 1975.

MODEL TYPE: Analysis.

PROPONENT: Vector Research, Incorporated, PO Box 1506, Ann Arbor, MI 48106.

POINT OF CONTACT: Stanley L. Spaulding, (313) 973-9210.

PURPOSE: BLDM is a research and evaluation tool used in systems effectiveness and weapons mix studies.

DESCRIPTION:
Domain: Land.

Span: Blue company to battalion-sized forces engaging Red regimental-sized forces.

Environment: Digitized terrain for representation of cover and concealment; some limited treatment of other battlefield environmental conditions such as day/night and smoke.

Force Composition: Combined arms forces including armored vehicles, dismounted antitank weapons; attack and scout helicopters, and artillery (the latter as firers but not as targets).

Scope of Conflict: Conventional weapons, including smart munitions.

Mission Area: Direct fire engagements with indirect fire support.

Level of Detail of Processes and Entities: Entities are represented as groups of systems, each consisting of one or more co-located weapons of a single type. Process models that determine acquisition and attrition of and by opposing groups consider physically measurable characteristics of the weapons such as pinpoint acquisition probabilities, non-pinpoint acquisition rates, firing times, dispersions and biases, round reliabilities, and probabilities of kill given a hit.

CONSTRUCTION:
Human Participation: Not required; some scheduled changes are permitted.

Time Processing: Dynamic, time-stepped model.

Treatment of Randomness: Deterministic--employs differential equations to approximate expected attrition over time.

Sidedness: Two-sided, symmetric.

LIMITATIONS: No fixed-wing tactical air; all movement is preplanned.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Minor improvements are frequently made to support specific study needs.

INPUT: Initial numbers of weapons by type and location, movement over time, cover and concealment, round and target choice criteria, target acquisition data, weapon performance data.

OUTPUT: Engagement history including numbers of survivor, killer-victim scoreboards, and cumulative rounds fired by type, all as a function of time into the engagement; summary statistics based on these detailed outputs such as force ratios and loss exchange ratios.

HARDWARE AND SOFTWARE:

Computer:	Not dependent on any particular hardware or operating system; has run on a number of mainframe and minicomputers.
Storage:	680,000 bytes.
Peripherals:	No special peripherals are required.
Language:	FORTRAN 66.
Documentation:	Users Manual describes original model; limited documentation exists for significant enhancements made to original model.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Two or three person days to incorporate extensive modifications into an existing performance data base; several person weeks to develop an entire new scenario and performance data base.

CPU time per Cycle: Approximately ten seconds per simulated engagement on an IBM 3090 mainframe.

Data Output Analysis: A few hours to a few days are required for analysis of a set of parametric runs.

Frequency of Use: Two or three studies per year.

Users: Current active user is VRI; former users have included a number of organizations in government and industry.

Comments: BLDM is one of many variants of the differential models of combat developed by VRI. Models in this family have included the Bonder/IUA model, AIDM (AMSAA Improved Differential Model), TRACOM (TRASANA Combat Model), AMSWAG (AMSAA War Gaming Model), and many others. A more aggregate version of the model is used to assess the results of direct fire engagements in a number of division through theater-level models, including tho Army's corps-level model VIC. Users of the BLDM family of models have included HQDA (Weapon Systems Analysis Directorate, Office of the Chief of Staff), AMSAA, TRASANA (now TRAC-WSMR), CACDA, Weapons Command, the Marine Corps, a variety of other government agencies, and several industrial users.

TITLE: BLOCKBUSTER.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Training and education.

PROPONENT: Office of the Training Simulations System Manager (TSSM), The Combined Arms Training Activity (CATA), Ft. Leavenworth, KS 66027-7000.

POINT OF CONTACT: CPT John Hughes or SFC Albert J. Malveaux, AV 552-3395/3189.

PURPOSE: BLOCKBUSTER is designed to train company commanders and staffs in staff procedures while operating in urban areas.

DESCRIPTION:
Domain: Land (urban).

Span: Primarily designed to company commanders.

Environment: BLOCKBUSTER is an independently based simulation that can handle day or night operations in all weather conditions.

Force Composition: Company and limited battalion assets.

Scope of Conflict: Conventional urban warfare.

Mission Area: Any urban terrain.

Level of Detail of Processes and Entities: Can process down to team level.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Uses randomly generated tables for combat resolution.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: Limited to company play in urban terrain.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:
Computer: None.
Storage: None.
Peripherals: None.
Language: None.
Documentation: None.

SECURITY CLASSIFICATION: None.

GENERAL DATA:
Data Base: None.

CPU time per Cycle: None.

Data Output Analysis: None.

Frequency of Use: BLOCKBUSTER Is no longer a primary simulation; it will be replaced by automated simulations in approximately 1992.

Users: Schools, Ft. Hood, Berlin Brigade.

Comments: N/A.

TITLE: BLUEMAX II (Flight Path Generator).

DATE IMPLEMENTED: 1982-1983.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Fraley, DSN 225-5550 or Commercial (703) 695-5550.

PURPOSE: BLUEMAX II is an aircraft flight path generator for use in weapon systems effectiveness studies.

DESCRIPTION:
Domain: Air.

Span: Individual.

Environment: Terrain relief.

Force Composition: Element.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Single aircraft. Movement of aircraft.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Dynamic, closed form.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: This is a five degree of freedom model (sideslip is not included).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Interactive input requirements depend on the type of maneuver desired and are requested by the computer when an appropriate maneuver is designated. Inputs include initial aircraft altitude airspeed, heading, pitch, weight, and drag. Further inputs will be required for changes in pitch heading, 'G', power constraints, and time for maneuver. Batch inputs include a "control file" that specifies the desired square of maneuvers and the parameters for each. Aircraft aerodynamic and propulsion data are contained in a data base. Digital terrain data is required for flight over terrain.

OUTPUT: Computer printouts listing aircraft position data, speed heading, pitch, roll, 'G', throttle setting, and AOA.

HARDWARE AND SOFTWARE:

Computer:	IBM 3081 (MVS), VAX 11/780 (VMS), PC-compatible (MS-DOS),SUN (UNIX).
Peripherals:	Terminal and printer.
Language:	FORTRAN 77.

Documentation: Documentation available from SURVIAC (Model Repository), Wright-Patterson AFB, OH.

SECURITY CLASSIFICATION: UNCLASSIFIED (without data base).

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: 30 minutes.

Data Output Analysis: N/A.

Frequency of Use: 3 to 5 times per month.

Users: AFSAA/SAG, AFWAL/FIAA, AFOTEC/OA, SURVIAC.

Comments: Output can be used by TAPM, ESAMS, TAC REPELLER, and RADGUNS.

TITLE: BMDES - Ballistic Missile Defense Engagement Simulation.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Coleman Research Corporation.

POINT OF CONTACT: Mark Patz, (407) 352-3700.

PURPOSE: BMDES is a research and evaluation tool. It was developed to evaluate the performance of interceptors and their supporting elements against ICBM RVs. It generates a detailed simulation of the one-on-one engagement between interceptor and target, and has the additional capability of simulating many-on-many engagements and performing ground defended footprint analysis for various interceptor and radar systems.

DESCRIPTION:

Domain: Ground-based and space-based weapon systems, used in conjunction with ground-based radar against space-borne threats.

Span: Regional, local or individual.

Environment: Earth models include flat-earth and spherical. Earth is non-rotating. ARDC-59 atmospheric model is used for computing pressure density and speed of sound as a function of altitude.

Force Composition: RV targets vs. interceptors and commit radars.

Scope of Conflict: Blue-team ground-based radars and kinetic energy weapons (KEWs) defending against red-team ICBM RVs.

Mission Area: Full-scale attack (also known as the "JCS mission"), Global Protection Against Limited Strike (GPALS), and all other SDI missions.

Level of Detail of Processes and Entities: Interceptor is modeled as a 5-DOF missile. Alternate guidance strategies are modeled. Radar is modeled using acquisition range, measurement frequency, and measurement uncertainty. Radar error can be measured as a function of range to target or SNR.

CONSTRUCTION:

Human Participation: Not required; the model is not interruptable (must be restarted if interrupted); human participation is not permitted.

Time Processing: Model is dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo (with deterministic processes).

Sidedness: One-sided, nonreactive.

LIMITATIONS: 10 on 10 engagements (10 radars, 10 interceptors against 10 targets); nonrotating earth.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Target mass properties, thrusts, drag characteristics, etc.; projectile stage mass properties, attitude control, guidance algorithm; weapon platform constellation size and orbital parameters; radar ground location; intercept windows.

OUTPUT: Results are oriented to graphical summaries. Engagement statistics such as closing velocities, angles, miss distance, and intercept times, as well as any simulation variable.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX with a VMS operating system or on PC with DOS.
Storage:	8000 blocks.
Peripherals:	Terminal. Printer with graphics capability is useful for printing out .plt files.
Language:	VAX FORTRAN (VAX) and Pascal (PC).
Documentation:	Documented in two Version 3.1 manuals (Analyst manual, User manual).

SECURITY CLASSIFICATION: Unclassified, but input and output files may be classified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: Scenario dependent (sim-time is nominally about 1/2 real-time).

Data Output Analysis: Postprocessors aid significantly in understanding the data. CRC proprietary graphical programs 'plotplus' and 'view' are used.

Frequency of Use: Frequently.

Users: Coleman Research Corporation.

TITLE: BODESIM - Barrier/Obstacle Deployment and Effectiveness Simulation Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-EN-A, P.O. Box 631, Vicksburg, MS 39181-0631.

POINT OF CONTACT: Phillip L. Doiron, (601) 634-3855.

PURPOSE: BODESIM is used primarily to analyze the deployment and effectiveness of countermobility obstacles in realistic terrain and environmental conditions. The model can simulate the deployment and effectiveness of U.S. obstacle systems and will have the capability in the near future to simulate the deployment and effectiveness of foreign obstacle mine systems. BODESIM can be used to produce tactical decision aides for a battlefield commander.

DESCRIPTION:

Domain: Land.

Span: Based on 1:50,000 scale map quadrangle.

Environment: Grid-based. Each 100m grid cell contains the terrain and environmental descriptions of the area. These terrain descriptions can include the topographic elevation; vegetation type, height, and density; soil type and moisture content; water depth, width, and velocity; urban structure height and density; and road type and width. The environmental descriptions can include the type and amount of precipitation and the snow depth.

Force Composition: Obstacle system assets, both BLUE and RED.

Scope of Conflict: Conventional and unconventional.

Mission Area: Countermobility operations.

Level of Detail of Processes and Entities: Simulate the performance of each individual obstacle emplacement system. The simulation is geared primarily to analyze the interactions of the obstacle systems with the terrain and environmental conditions occurring in the selected minefield areas. The obstacles can be located anywhere on a 1:50,000 scale map quadrangle and can be of any size and configuration.

CONSTRUCTION:

Human Participation: Required to select the obstacle system parameters.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: In the near future, foreign obstacle emplacement systems will be included. BODESIM will be implemented on an MS DOS-based PC.

INPUT: Relevant terrain and environmental factors and obstacle emplacement system characteristics.

OUTPUT: Produces graphical display and tabular printouts of obstacle emplacement and effectiveness performance.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a MicroVAX computer with VMS operating system.
Storage:	4.5 MB required to run the model.
Peripherals:	Minimum requirements: 1 printer, 1 Raster 380 graphics terminal, 1 VT100 terminal.
Language:	FORTRAN.
Documentation:	Model description report (in preparation).

SECURITY CLASSIFICATION: Model is unclassified, but some data and model outputs are classified.

GENERAL DATA:

Data Base: 3 months to prepare digital terrain data base.

CPU time per Cycle: 27.33 seconds.

Data Output Analysis: Manual.

Frequency of Use: Used when required to support research and development efforts.

Users: U.S. Army Engineer Waterways Experiment Station.

Comments: Model has been activated on the AirLand and Battlefield Environment Test-Bed System.

TITLE: BONeS - Block Oriented Network Simulator.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis (can also be used as training model).

PROPONENT: Comdisco Systems, Inc., 600 Lawrence Avenue, Suite 2B, Lawrence, KS 66049.

POINT OF CONTACT: William LaRue, (913) 841-1283.

PURPOSE: BONeS is used primarily as a research and evaluation tool that provides an integrated, interactive, and graphical environment for simulation-based analysis and the design of communication networks. BONeS minimizes the amount of simulation code that a network engineer has to develop. Programming is replaced by graphical definition of the network topology and protocol functions that are translated by BONeS into simulation code. BONeS also provides on-line help and error checking, as well as management of data bases that contain simulation models and results. These features permit the network engineer to concentrate on problem definition and analysis rather than on the mechanics and mundane details of the simulation.

DESCRIPTION:

Domain: BONeS models all computer communication networks.

Span: Global.

Environment: Hierarchical.

Force Composition: N/A.

Scope of Conflict: N/A.

Level of Detail of Processes and Entities: The postprocessor analyzes and displays the results of a simulation. It allows the user to specify a conditional that selects the exact data from a probe file that is of interest and rejects the rest of the data.

CONSTRUCTION:

Human Participation: Required for model development and specification.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Limited to determining network performance. Does not verify protocol correctness.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expanded module library, animation, and topology editor.

INPUT: Graphically specified network topology, data structures, and protocol functions are entered through a mouse-based window system.

OUTPUT: Simulation results (delays, throughput, buffer occupancy, etc.) from the postprocessor are displayed and are available as printouts or graphs.

HARDWARE AND SOFTWARE:

Computer: SUN 3 or SUN 4 under SUN/OS 4.0.

Storage: 8 MB RAM, 1/4-inch, 60 MB cassette, 141 MB hard disk.

Peripherals: Minimum requirement: Postscript printer.
Language: LISP and "C."
Documentation: Programmer's manual and user's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: One hour to several months required to develop model.

CPU time per Cycle: Dependent on data base size; large networks can take hours.

Data Output Analysis: Less than 30 seconds for typical problem.

Frequency of Use: Not yet determined.

Users: Comdisco Systems, Inc., Air Force Systems Command (AFSC).

Comments: The BONeS product will be commercially available December 1989. BONeS is the result of an AFSC Small Business Innovative Research effort under RADC Contract F30602-87-C0013.

TITLE: BOSM - Balance of Sustainment Model.

DATE IMPLEMENTED: February 1990.

MODEL TYPE: Analysis.

PROPONENT: Office Deputy Chief of Staff Logistics (ODCSLOG).

POINT OF CONTACT:
CONTRACT TITLE: Family of Resource Predictive Models.
COTR: Theron Fuller (703) 695-0432.
PMSDA (AO): Pat Wakefield (703) 695-0432.
AGENCY: PMSDA.
FUNCTIONAL POC: Rose David, RMI, ODCSLOG, (703) 697-3122.

PURPOSE: The BOSM is a Resource Predictive Model developed for HQDA in support of POM building process. BOSM provides HQDA with a sophisticated analytical autmated methodology for determining the optimum balance of programmed resources and wartime planning capability. The BOSM assesses weapons system availability over time; integrates related end-items, secondary items, ammunition, fuel, (and other classes of supply) required to sustain the weapon system operability. With this model analysts can determine requirements for classes of supply in the form of "eaches" and "dollars" necessary to sustain a given force, in a given theater of operation, for a specified period of time.

DESCRIPTION:
Domain: Army, land.

Span: Global, Theater, Regional War Reserve Guidance Letter (S), HQDA, ODCSLOG, and AR-11 (S), HQDA, ODCSLOG.

Environment: None.

Force Composition: Army, (Active, Reserve, Guard) Component, (TOE, TDA, TDA aug TOE) claimant level of detail (UIC and Non-units).

Scope of Conflict: Weapon systems, as determined by HQDA, ODCSOPS/ODCSLOG, published by SIMA, War Reserve Stockage List (WARSL).

Mission Area: All conventional mission statements except unconventional warfare.

Level of Detail of Processes and Entities: The scope is from the smallest Army claimant with a Unit Identification Code (UIC), to the total Army. For example, the model can process sustainment for a single tank with its related Class V, IX, and III, or it can process every tank with their related Class V, IX, and III. This process can be applied to all 2500 War Reserve Stockage Items (WARSL) determined by HQDA.

CONSTRUCTION:
Human Participation: Required for decisions and processing, however the BOSM can achieve a result with little or no user interface.

Time Processing: Depending on the scenario, the BOSM has the flexibility to be dynamic or static. In the dynamic mode it is evant-step.

Treatment of Randomness: The BOSM is basically a deterministic model, that uses computations based on factors, rates, and consumption data over time.

Sidedness: The BOSM is a two-sided, symmetric, reactive model. It can be tested by a single operator and operated by as few as 1 and can have as many stations as required.

LIMITATIONS: The BOSM is developed specifically for predicting Army War Reserve resources, for all classes of supply.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The BOSM is being enhanced to encompass all classes of supply for the Army. The model is being demonstrated to the Joint Staff for possible use as a sustainment model for all services.

INPUT: The BOSM takes as input all of the equipment requirement densities and onhand data for every Army UIC, all of the onhand stocks stored at storage locations world-wide, in every theater that they are deployed to during the scenario period. The input includes factors, rates and consumption data for all classes of supply.

OUTPUT: BOSM produces logistic resource data in the form of graphs, charts, tables, printouts and summaries.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on IBM compatible 286 - 386 desktop computer.
Storage:	44 megabytes Bernoulli Box.
Peripherals:	Minimum requirements: 1 printer dot matrix or laser).
Language:	Clipper 5.0.
Documentation:	Available.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: They can be prepared by the functional analyst running the model. One person would need approximately two weeks to prepare data bases.

CPU time per Cycle: 2 - 5 minutes.

Data Output Analysis: On-screen analysis and hardcopies of data.

Frequency of Use: Varies by HQDA staff agency, but it has been used many times over the past year by those listed below.

Users: PMSDA and ODCSLOG.

Comments: It is managed through a General Officer steering group made up of representatives of HQDA staff. It is continually upgraded based on priorities established by the configuration control board.

TITLE: Bottom Line.

DATE IMPLEMENTED: September 1986.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: Bottom Line, a seminar exercise driver, is a budget impact analysis program. It is a role-playing game designed to promote student understanding of the executive-level decision making process, relationships involved in the allocation of limited national resources, and the subsequent impact on the state of the nation.

DESCRIPTION:

Domain: President, cabinet and budget advisers.

Span: Simulates the 4 years of a presidential term.

Environment: Not applicable.

Force Composition: Not applicable.

Scope of Conflict: Not applicable.

Mission Area: Not applicable.

Level of Detail of Processes and Entities: Cabinet level of detail with 17 areas of budget manipulation. Areas include both receipts and expenditures.

CONSTRUCTION:

Human Participation: Required for budgeting decisions and resource allocations.

Time Responses: Students must complete all 4 game years within 3 hours. Bottom Line maintains the game clock.

Treatment of Randomness: Bottom Line is deterministic except for the probability of conventional war. Its algorithms, based on current economic theory, include Okun's Law and the Phillip's Curve.

Sidedness: Bottom Line is a single-sided game with each team attempting to maximize end-game points. Many teams may participate, with the end score being manually compared to determine an overall result.

LIMITATIONS: This game does not accurately account for econometric anomalies of the Phillip's Curve.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Bottom Line simulates 4 years of play. At the beginning of each year, players enter political and economic decisions concerning:

National Receipts:

1. U.S. Foreign Aggressiveness.
2. Individual Income Taxes.
3. Corporate Income Taxes.
4. Social Insurance.

5. Excise Taxes.
6. Estate and Gift Taxes.
7. Miscellaneous Receipts.

National Expenditures:

8. National Defense.
9. International Affairs.
10. Space and Technology.
11. Health and Welfare.
12. Community Development.
13. Veteran's Benefits.
14. Agriculture.
15. Commerce and Transportation.
16. Education and Training.
17. General Government.

OUTPUT: Bottom Line calculates and reports the impact of the decisions on the national economy. The player can then "what-if" the political-economic decisions until acceptable results are obtained. The player then moves on to the next year. At the end of the fourth year the player should satisfy the following Parameters:

a) Reelection in 1988.
b) Probability of nuclear war below 7 percent.
c) Unemployment at or below 4.9 percent (full employment).
d) Achieve real GNP growth of 3 percent per year.
e) Internal Unrest Index below 5.5.
f) Inflation below 4 percent per year.
g) Discomfort Index below 10.
h) Limited War Trend Index 0 or above 40.
i) U.S. World Influence Index 5.25.
j) Cold War Index above 5.
k) Budget deficit minimized.

HARDWARE AND SOFTWARE:
Computer (OS): IBM-compatible MS-DOS machine with floppy disk drive and 256 kilobytes random access memory.
Storage: Requires 108 kilobytes for executable and 10 kilobytes for archival data.
Peripherals: Monochrome monitor (color optional), printer.
Language: MS-PASCAL and MS-Assembler.
Documentation: User and Maintenance Manuals available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Requires 1 hour to update.

CPU time per Cycle: Not applicable.

Data Output Analysis: Produces hardcopy of output data and historical archive of previous student inputs.

Frequency of Use: Used six times per year by user listed below.

Users: Professional Military Comptroller Sc[illegible] of the Center for Professional Development.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: BPS - Battlefield Planning System.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army TRADOC Analysis Command (TRAC-WSMR), White Sands Missile Range, NM 88002-5502.

POINT OF CONTACT: MAJ Bruce T. Robinson, (505) 678-3802, AV 258-3802.

PURPOSE: BPS is an automated decision aid that assists the brigade and division staffs in the planning process. It is used for skills development, primarily terrain analysis and wargaming courses of action.

DESCRIPTION:

Domain: Land and air.

Span: Regional, including portions of West Germany, Korea, Southwest Asia, Egypt, and the National Training Center.

Environment: Uses digitized terrain at 100-meter granularity. Terrain data includes elevation, land use, soil type, roads, rivers, obstacles, and vegetation height. Models the weather, employs the WES-developed mobility model, and utilizes precomputed line-of-sight probabilities.

Force Composition: BLUE and RED divisional forces.

Scope of Conflict: All conventional weapons organic to the BLUE and RED divisions.

Mission Area: Standard divisional combat mission, including attack helicopters and artillery.

Level of Detail of Processes and Entities: Entities range from individual weapons systems to brigade-sized units. Attrition, logistics, and movement are employed down to single entities.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Model can be run in two modes with attrition determined purely by Lanchestrian or stochastic means; direct computation of probability of kill and Monte Carlo determination of results.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Size of digital map and number of weapons, unit routes, and targets limited by capabilities of the computer.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhanced logistical simulations are planned.

INPUT: Terrain, movement, unit instructions, force composition, weapons data, and weather.

OUTPUT: Printouts of attrition and logistics data and graphs of simulation results. Also generates operation orders, operations overlays to scale, color maps, relief maps, and line-of-sight profiles.

HARDWARE AND SOFTWARE:

Computer:	Runs on Hewlett-Packard 6000 series with UNIX operating system.
Storage:	Requires 4 MB RAM, 20 MB storage.
Peripherals:	One printer (preferably color), one graphics plotter, one color monitor with 8-bit planes.
Language:	Pascal, "C," FORTRAN.
Documentation:	Minimum documentation available.

SECURITY CLASSIFICATION: Unclassified without weapons data.

GENERAL DATA:

Data Base: Generation of new, high-quality digitized terrain can take several months (DMA). Likewise, weapons data is subject to availability from AMSA.

CPU time per Cycle: One hour of combat for brigade-sized forces requires no more than five minutes of CPU time.

Data Output Analysis: Printouts and graphs are easily interpreted by the user.

Frequency of Use: Varies by user. Used weekly by the 8th ID.

Users: 8th ID, 3rd ACR, CGSC.

Comments: BPS was developed to support the 8th ID. Model is continuously updated on their request.

TITLE: Buildup.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: Studies, Concepts and Analysis Division, Logistics Directorate, (J-4), The Joint Staff, The Pentagon, Room 2E827, Washington, DC 20318-4000.

POINT OF CONTACT: CDR K.J. Kelley, (703) 696-6110, AV 225-9212.

PURPOSE: Buildup is an intratheater simulation model that sequentially processes movement requirements through a transportation network representing a specific area. Buildup has been used to model both CONUS and Warsaw Pact intratheater movement in the European Theatre of Operations.

DESCRIPTION:
Domain: Land.

Span: Can accommodate any theater including limited sea movement.

Environment: Network-based rail and road movement including nodes, depots, and associated capacities for rail and vehicle movement.

Force Composition: Various military land transportable units up to and including divisions, squadrons, and various support units.

Scope of Conflict: Conventional, although conflict is not modeled.

Mission Area: Intratheater mobility.

Level of Detail of Processes and Entities: Individual vehicles and rolling stock are loaded by capacity. Onload, offload, and transfer times and speeds for each vehicle class are modeled. Each link has a mode, length, and capacity in vehicles per unit time.

CONSTRUCTION:
Human Participation: Limited to preparation of data base and analysis of output.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: N/A.

LIMITATIONS: No attrition of material, and packages (cargo) are delayed at their origin to avoid delays en route. The order in which the packages are presented to the model affects the solution. The following limits, although not a program constraint, are typical of problems run: 200 simulation days (time periods), 8000 links, 5000 packages.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Three input files are required for a Buildup solution. The scenario file includes the vehicle characteristics, number of days being simulated, and aircraft utilization rates. The network file includes links, nodes, and capacities. The requirements package file contains data on each package, as origin, destination, availability, and vehicle requirements. A fourth optional file may be used to vary link capacities and vehicle availability.

OUTPUT: Buildup produces two output files that can be viewed at the terminal or printed in hardcopy. The solution file provides a summary report of link status and daily vehicle usage. The movement file provides data for each package including destination, links used, and a record of when the package entered each node. This data is used by a postprocessor to produce a time-phased profile of the arrival of units at their ultimate destination.

HARDWARE AND SOFTWARE:

Computer:	VAX/MULTICS.
Storage:	Varies with the size of the data base and network.
Peripherals:	Computer terminal and printer.
Language:	FORTRAN.
Documentation:	Buildup User's Manual (published by General Research Corporation).

SECURITY CLASSIFICATION: Unclassified (without data).

GENERAL DATA:

Data Base: Ten man-hours to set up an average data base.

CPU time per Cycle: 30 minutes per model cycle.

Data Output Analysis: Between 1 and 10 man-days to analyze results.

Frequency of Use: No longer used for logistic simulation by DOD activities.

Users: DIA, OASD (PA&E), JDSSC, JCS (J-4).

Comments: Model supplanted by more state-of-the-art simulations.

TITLE: BULLET - Battalion/Unit Level Logistics Evaluation Tool.

DATE IMPLEMENTED: October 1989.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Operational Evaluation Command/BDM International, Inc.

POINT OF CONTACT: OEC: Mr. Hank Romberg, (703) 756-2342; Fire Support Directorate. BDM: Dr. Ernie Montagne, (703) 848-5818/Mr. Alan Davis, (703) 848-6614.

PURPOSE: BULLET provides data used in analysis of the degree in which units can support their ammunition requirements in various tactical situations. The model is a discrete event simulation of ammunition consumption, transport, storage, and resupply. BULLET can be used to analyze weapon systems effectiveness or deal with force capability and requirements and resource planning. It can also be used as a training device for logistics planning by teams or individuals.

DESCRIPTION:

Domain: Land.

Span: Model flexibility allows level of detail ranging from theater to platoon.

Environment: Network based. The user defines the logistics network over which ammunition is stored, transported, resupplied, and consumed. BULLET allows for variation of day/night, road conditions, storage, haul, and reload capabilities, transport distances, RAM and combat damage, unit configurations, ammunition types, constrained supply rates, and ammunition consumption.

Force Composition: BULLET is one-sided. Effects of combat are reflected in attrition rates. BULLET can represent combined forces ranging from platoon to theater.

Scope of Conflict: BULLET can represent resupply of any type of ammunition.

Mission Area: Ammunition resupply in mid or high intensity conflicts.

Level of Detail of Processes and Entities: BULLET represents each weapon, round of ammunition, and ammunition resupply vehicle explicitly. Each unit is represented as a node in the resupply network. Processes: BULLET represents each firing of ammunition by each weapon. Ammunition reorder is triggered by a threshold for required resupply. Weapon, truck, and unit movement is represented for both tactical and survivability moves. Queuing at ammunition resupply facilities and reload times are represented. Stochastic processes include reload times, maintenance and failure rates, and combat damage.

CONSTRUCTION:

Human Participation: Users must develop the scenario and provide input in tabular form for the logistics network, weapons and vehicles, ammunition basic loads, unit movements, and ammunition consumption.

Time Processing: Dynamic event-stepped model. User may input the total simulation time.

Treatment of Randomness: Exponential time between failures. Random selection of vehicles suffering combat damage. Log normal reload times.

Sidedness: One-sided model. Threat effects are represented by random combat damage to weapons and vehicles.

LIMITATIONS: BULLET does not assess weapons effects. Battlefield geometry is represented only by the logistics network.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Interactive graphics for modification of scenarios "on-the-fly". Applications to palletized loading systems and tank battalions. Automated generation of fire mission lists.

INPUT: Logistics network, weapon parameters, truck and trailer parameters, unit movement tables ammunition basic loads by type, ammunition consumption list, simulation factors and randomness.

OUTPUT:

Ammunition Availability.
Ammunition Shortfalls.
Equipment Utilization.
Transport Equipment Trip Summary.
Ammunition Consumption.
Fire Mission Profile.

HARDWARE AND SOFTWARE:

Computer:	PC 286 or 386 based.
Storage:	2 megabytes storage, 1 megabyte RAM.
Peripherals:	Printer.
Language:	SIMSCRIPT II.5.
Documentation:	System Design, Users and Programmers Manuals, Three Day Training Program, Analysis Plan.

SECURITY CLASSIFICATION: Unclassified, data bases may be classified.

GENERAL DATA:

Data Base: Initial data collection takes approximately two man-months. Excursions can be designed in a few days.

CPU time per Cycle: 286-based: 45 minutes of CPU time for a 96-hour simulation. 386-based: 10 minutes of CPU time for a 96-hour simulation.

Data Output Analysis: Output is in formatted DOS text files which can be printed or used as input for statistical software.

Frequency of Use: 15-20 excursions during pre-test or post-test analysis. 5-10 for training purposes.

Users: U.S. Army OPTEC, U.S. Army Field Artillery Center.

Comments: Study Advisory Group consisting of representatives from OPTEC, USAFACS, AMSAA, MICOM, TACOM, AMC, CAA, and DOT&E contributed to model development.

TITLE: C2 - Command and Control Simulation.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Training.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: Mr. Bill Snyder, (49) 631-536-6507, DSN 489-6507.

PURPOSE: The WPC C2 Simulation models the various C2 systems used by exercise participants.

DESCRIPTION: C2 Simulation permits the transmission of both free text and formatted messages between players using alphanumeric terminals.

Span: C2 models the British Air Staff Management Aid (ASMA), the Baltic Tote Systems, Computer Assisted (TOACA), the Southern Region and Central Region C2 Information Systems (CCIS), and Teletype (TTY) communications.

Mission Area: Command and Control.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Dynamic, event-stepped model.

LIMITATIONS: Emulates NATO C2 systems only. Interfaces with AWSIMS.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Redesign southern region CCIS. Interface to real world CCIS and the Joint Theater Level Simulation.

HARDWARE AND SOFTWARE:
Computer: Hosted on a VAX with VMS.
Storage: Varies with C2 system emulated.
Peripherals: Each user requires a CRT input capability.
Language: INGRES, FORTRAN, and DCL.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Frequency of Use: 8-10 times per year.

Users: WPC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: C2DA - GTE Command & Control Decision Aid.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis (but can be used as an exercise driver).

PROPONENT: GTE Government Systems Corp, Needham, MA 02194.

POINT OF CONTACT: George Leonard, Commercial (617) 455-3523; David Hart, Commercial (617) 455-3794.

PURPOSE: The C2DA is an operations support tool that provides real-time assessment of the intent of high interest hostile elements (e.g., military forces, terrorists, etc.) to pursue specific courses of action (where advance notice of that intent is deemed essential by the U.S. Government). C2DA pattern recognition capabilities also provide early indications of intent to pursue specific courses of action. Incoming reports of related activity drives the C2DA assessment processes. In addition, what-if scenarios can be run off-line for training or exercise purposes. The data base reflecting each course of action is generated by the operator.

The C2DA features both analytic and artificial neural network processing techniques to derive assessments (in the form of confidences) that particular courses of action are likely to occur and a user interface that permits the operator to graphically represent (in template form) the sequence of events (the operator-generated data base) expected to occur for each course of action.

DESCRIPTION:

Domain: Land, Air, Sea, Undersea or any combination of these

Span: Any level can be accommodated.

Environment: Anything that can be described in a hierarchical data base can be used; e.g., types of weather, enemy course of action indicators, terrain types, etc.

Force Composition: Any mix can be accommodated.

Scope of Conflict: Any category of weapon, both red and blue, can be accommodated. Also can include C2, logistics, engineering, communications, etc.

Mission Area: Any combination of weapons and procedures can be used.

Level of Detail of Processes and Entities: The size of the entity will vary based on the expected contribution of individual force elements to the C2DA output, an assessment of the intent of the combined force to pursue a particular course of action.

CONSTRUCTION:

Human Participation: Possible, but not required for decisions; data base developed by operator. Actual observations of the expected sequence of events, as they are entered by the operator, drive the course of action calculations. The C2DA is interruptable.

Time Processing: Analysis is closed form but driven by discrete events.

Treatment of Randomness: Deterministic.

Sidedness: Normally, one-side modeled. If more sides modeled, there is no relationship between the sides.

LIMITATIONS: C2DA used for assessments, driven by components and the relationships between those components.

PLANNED IMPROVEMENTS AND MODIFICATIONS: X-windows version for enhanced portability.

INPUT: (1) Templates are developed that indicate the collection of actions that are probable for various enemy courses of action. (2) Observations that match template events are entered and confidences are generated to indicate the likelihood of each course of action. (3) Neural nets are trained to recognize specific patterns of observations that are early indicators of a particular course of action.

OUTPUT: Outputs are (1) plots (using an analytic processing technique) of likelihoods of enemy courses of action, (2) identification of events that went undetected or the potential of deception on the part of the enemy, (3) artificial neural net recognition of patterns previously trained to recognize.

HARDWARE AND SOFTWARE:

Computer:	Currently runs on a Sun Workstation.
Storage:	Five Megabytes of disk.
Peripherals:	Color display.
Language:	"C".
Documentation:	Published User's Manual.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Population of data base is accomplished by user. The data base is quickly developed in the form of templates (a hierarchy of events).

CPU time per Cycle: Less than two seconds for a complete analysis.

Data Output Analysis: Used as an analysis tool. Output comes in a variety of forms.

Frequency of Use: Designed to use daily.

Users: USCENTCOM (for evaluation).

Comments: Upgrades based on customer requirements.

TITLE: C3EVAL - Command, Control, and Communications Evaluation Model.

DATE IMPLEMENTED: In continuous development since 1985 with new features added each year since then.

MODEL TYPE: Analysis.

PROPONENT: Joint Staff (J6 & J8).

POINT OF CONTACT: Dr. John T. Dockery, Joint Staff, J6E, The Pentagon, Washington, DC 20318-6000, (703) 693-3492. Also: Dr. Robert Atwell, Institute of Defense Analysis, 1801 N. Beauregard St, Alexandria, VA 22311-1772, (703) 845-2255.

PURPOSE: C3EVAL is both a Research and Evaluation Tool and an Operational Support Tool. It is designed to simulate the interaction of message traffic between communications nodes and ongoing combat based on command and control (C2) rules with the overall goal of assessing the function of C2 in terms of combat outcomes. While neither the combat "half" nor the nodal communications "half" are suitable for either specific weapon systems analysis or specific communications systems analysis respectively, the interactions between the two parts generates a rich set of interactions from which to judge the systems effectiveness of C3 architectures in directing weapons systems. As such it touches all three options 1 (a), (b), and (c) of this particular sub-head.

DESCRIPTION:

Domain: The model fights land combat with some air assets but does so in an abstract space using a "killer-victim" scoreboard approach to assess losses and postures.

Span: Scale is at the selection of the user from implicit battalions to explicit corps (or theatre for C3 assets).

Environment: Physical environment is not used.

Force Composition: Red and Blue forces in the detail desired as to force mix, and force combinations (as long as they are within the same nodal communications structure).

Scope of Conflict: With the exception of nuclear there is theoretically no limit on weapon categories. Currently wired for conventional type.

Mission Area: Special attention is given to Sensors, Deep Attack, Close Air Support, Indirect Fire, and Helicopter support. Essentially no limit if necessary code module is written. Currently covers most Red & Blue mission areas.

Level of Detail of Processes and Entities: (i) Communications "half": Processing Rules for messages, message routing, message priority, details of sender/receiver, and effects on transmission; basically an architecture approach with equipment/systems represented functionally. Logistics message traffic is also simulated. It is essential to note that combat decisions in the C2 rules are based on the commanders' perception while the combat itself proceeds on ground truth.

(ii) Combat "half": Units down to battalion but can be specified at any level in the data with suitable modification to "scoreboard." Basically an allocation is performed using C2 rules based on perceptions generated by arriving message traffic, a battle is "fought," and postures changed. Cycle time are currently every fifteen minutes but this is totally adjustable. It is essential to note that combat need only provide a plausible stimulus to the decision side of the model in order to generate plausible message traffic.

CONSTRUCTION:

Human Participation: Not required. This is a closed end model running on internal logic. However, it is prudent to intervene every 2-3 days of simulated combat.

Time Processing: This is a time-step MODEL with event-step features.

Treatment of Randomness: The communications side is deterministic or random or any combination by node at the user's specification. Combat is deterministic although this too can be readily altered. The latter is not recommended as the model is designed to play out C3 options against a constant combat backdrop.

Sidedness: In general, the combat is two-sided and asymmetric, as well as reactive to message traffic.

LIMITATIONS: Those limitations characteristic of potential/anti-potential methodologies; e.g., combat is fundamentally non-local with no movement.

PLANNED IMPROVEMENTS AND MODIFICATIONS: C3EVAL has undergone continuous modification since its inception with the goal of keeping upward and downward compatibility. Changes have resulted in new features while keeping the basic structure. As it shares the same basic combat module architecture with TACWAR, anticipated changes will be directed at using C3EVAL to input more specificity as to the play of C3 assets in TACWAR, which is currently totally subjective. Whether the two will run in parallel or be interconnected (or both) is an open question.

INPUT: The VAX version has a preprocessor and one is under design for the PC based version. The combat side uses input similar to TACWAR; e.g., troop strength, PKs by weapon type, etc.; but also extensive allocation rules. The communications and C2 side input functional descriptions of message flow architecture.

OUTPUT: There exists a preprocessor to graph the results of combat losses and message traffic histories; e.g., delays, reroutes, etc. Output detail is under user control and includes a page of options.

HARDWARE AND SOFTWARE:

Computer:	VAX under VMS and PC (386 based) machines under DOS.
Storage:	Not a problem unless extensive output is generated. Conventional hard drives (both VAX and PC) easily accommodate the model.
Peripherals:	Plotters.
Language:	FORTRAN with Forms Management software for the VAX and EXCEL 3 anticipated for the DOS based machines.
Documentation:	Complete but scattered in IDA reports. Self teaching demonstration with documentation being built (1991).

SECURITY CLASSIFICATION: This is strictly a function of the data.

GENERAL DATA:

Data Base: Hours to days depending upon size of game, and whether an original game or a variant is proposed.

CPU time per Cycle: Runs are of the order of minutes per simulated day.

Data Output Analysis Hours to days depending on user's objective and volume selected.

Users: Primary--J6 and J8.

TITLE: CAMMS - Condensed Army Mobility Model System.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis (primarily as a tactical decision aid, but also useful in training and education as an exercise driver and training model).

PROPONENT: Mobility Systems Division, Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, MS 3981-0631.

POINT OF CONTACT: Mr. Newell Murphy, (601) 634-2447; Mr. Donald Randolph, (601) 634-2694.

PURPOSE: CAMMS describes vehicle and foot soldier mobility on- and off-road and was developed primarily to provide tactical decision aids for U.S. Army operations at corps level and below. It can also be used to assess vehicle force mobility capabilities and as an exercise driver.

DESCRIPTION:

Domain: On road, off road (forests, farmlands, etc.), across gaps.

Span: Useful from individual vehicle or soldier level up to corps level.

Environment: Off-road area terrain ordinarily in raster, roads and linear features in vector, and urban areas in raster or vector. Each terrain type described by all factors that significantly influence mobility (e.g., slopes, surface, vegetation, visibility, obstacles). The overall terrain description can be developed from TTADB, ITD, or similar terrain data bases developed by DMA. Models weather effects on historical, near-real-time, and forecast bases; can model day and night mobility.

Force Composition: Joint and combined forces, RED and BLUE.

Scope of Conflict: Can adjust vehicle mobility relative to battlefield damage and set rules for restricting or eliminating mobility as function of conventional, unconventional, or nuclear warfare.

Mission Area: All missions involving U.S. military ground vehicle mobility.

Level of Detail of Processes and Entities: Lowest entity is single vehicle or soldier, up to columns and units of vehicles or soldiers. Processes are primarily deterministic based on field-validated relations. Monte Carlo procedures interpret terrain and historical weather data. Mobility on road, off road, and across gaps is modeled in a modular software format that compares pertinent vehicle and driver or soldier capabilities with those necessary to satisfy specified terrain, weather, mission requirements. Outputs can be used to evaluate avenues of approach, gap crossing sites, vehicle optimum mix, and cross-country routes.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Mobility treated in deterministic fashion, terrain and historical weather by measured data, then limited Monte Carlo procedures.

Sidedness: Two-sided, symmetric. Single operator or multiple operators.

LIMITATIONS: Limited capability to model mobility in snow, engineer-assisted gap crossing, avenues of approach, military-emplaced obstacles, cover and concealment, formation movement, and urban mobility.

PLANNED IMPROVEMENTS AND MODIFICATIONS: In process of removing limitations.

INPUT: Prescribed digitized data describes vehicle, driver, terrain, weather and scenario factors that have a significant effect on ground vehicle and soldier mobility for specified mission requirements.

OUTPUT: Computer screen and hardcopy maps, overlays, and tabulations suitable for mobility tactical decision aids.

HARDWARE AND SOFTWARE:

Computer:	PC version designed to run on IBM PC-compatible with MS DOS operating system; VAX version on VAX computers with VMS operating system.
Storage:	Before data base installed: PC version 4 MB; VAX version 26,000 blocks (12 MB).
Peripherals:	Minimum (both versions) 1 printer; can drive printers and graphics terminals.
Language:	PC version: "C," FORTRAN, Assembler, Pascal; VAX version: FORTRAN.
Documentation:	Both versions well-documented; recent operator's manual.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: For one quad sheet (about 22 km x 23 km), all terrain factors and ordinary resolution (100m for off-road terrain and 10m for roads and linear features); digitizing requires one man-month. Vehicle, driver, and historical weather data is preprocessed and requires limited preparation time.

CPU time per Cycle: For one quad and normal terrain data resolution, about 6 minutes on PC and 2 minutes on VAX.

Data Output Analysis: Postprocessor gives graphical and textual images for use as tactical decision aids.

Frequency of Use: Varies; used at least several times per year.

Users: U.S. Army I, III, and V Corps; 9th Infantry Division, Training and Doctrine Command, Command and General Staff College, Military Academy, Combined Arms Center, Defense Mapping School, U.S. Army Waterways Experiment Station.

Comments: Upgraded regularly; used as mobility model in major U.S. Army programs.

TITLE: CAM-X - Corps Ammunition Model Expanded.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Bruce Lasswell, AV 687-1050/3449.

PURPOSE: CAM-X is an operations support tool designed to furnish information on how ammunition requests may be satisfied under constraints of equipment availability, transportation networks, and enemy attack.

DESCRIPTION:

Domain: Land and air.

Span: CAM-X handles a wide range of scenarios and transportation networks. The user can select any geographic area where data is available.

Environment: CAM-X models a multi-mode transportation network.

Force Composition: Variable.

Scope of Conflict: Variable.

Mission Area: Transportation system.

Level of Detail of Processes and Entities: Requirements for ammunition are input to the model. Ammunition vehicles are loaded and move over the given network to the user. Vehicles may be attacked when halted. All phases of transportation are considered.

CONSTRUCTION:

Human Participation: Not required--scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Either stochastic, Monte Carlo or basically deterministic as required by the user.

Sidedness: One-sided.

LIMITATIONS: Model requires extensive data input, and is not directly related to combat models.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Transportation network, ammunition demands (from other model outputs or SCORES scenario), destruction probabilities, rebuild times, and unit locations and movement.

OUTPUT: Ammunition delivered, ammunition destroyed, and preferred modes and schedules.

HARDWARE AND SOFTWARE:

Computer: VAX 11/780.
Storage: Variable.
Peripherals: Printer.
Language: FORTRAN IV, GASP IV, and FORTRAN 77.
Documentation: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Varies.

Data Output Analysis: Two Weeks.

Frequency of Use: Cyclical.

Users: U.S. Army Ordnance Missile and Munitions School.

Comments: CAM-X was created using the Models of the Army Worldwide Logistics System (MAWLOGS).

TITLE: Canadian Land Forces Research War Game.

DATE IMPLEMENTED: 1978/79.

MODEL TYPE: Analysis.

PROPONENT: Directorate of Land Operational Research (DLOR) and Operational Research and Analysis Establishment (ORAE), Ottawa, Ontario, K1A OK2, Canada.

POINT OF CONTACT: Mr. A.G. Boothroyd, Director Land Operational Research, (613) 992-8960, AV 842-8960.

PURPOSE: The Canadian Land Force Research War Game is used primarily to provide an objective and detailed simulation of warfare to test the effects of weapon systems and organizations.

DESCRIPTION:
Domain: Land and air.

Span: Accommodates any theater for which map coverage is available. Generally operated in Northwest European and Canadian localities.

Environment: Terrain detail as per maps in use at the preferred 1:10 000 scale. No limitations on night operations. Weather and seasonal inputs can be varied to fit the requirement.

Force Composition: Any mix of BLUE and RED forces can be accommodated; BLUE usually up to brigade group level and RED up to the divisional (+) level.

Scope of Conflict: Can accommodate virtually all conventional weapons and their effects. Primarily conventional warfare but some limited nuclear and chemical effects can be played.

Mission Area: All conventional missions except unconventional warfare.

Level of Detail of Processes and Entities: Entity: The game can be played at various levels. The resolution can vary from individual weapons to company groups. Normally BLUE is at platoon size and RED is at company size but each force has certain major weapons at the individual level. Processes: Stochastic determination of events is used with the exception of close combat. Rule and assessment areas are detailed computer simulations that can stand alone and can be used independently.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic in five-minute time-steps.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Real time/game time ratio increases with complexity and size of the game.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at this time.

INPUT: Scenario, orders, operational concept, tactics or guidelines, weapon effects information, detailed organization and equipment holdings, and analysis plan.

OUTPUT: Detailed period-by-period record of each piece showing strength, location, status, suppression, and ammunition holdings; detailed records of interactions; and data outputs based on the analysis plan.

HARDWARE AND SOFTWARE:
Computer: VAX 750.
Storage: Two 300-MB disk drives.
Peripherals: Line printers and tape drives.
Language: FLECS/FORTRAN.
Documentation: Partial.

SECURITY CLASSIFICATION: War game and simulations unclassified.

GENERAL DATA:
Data Base: Four man-months.

CPU time per Cycle: Unknown.

Data Output Analysis: As per analysis programs.

Frequency of Use: One to two game series per year.

Users: Proponents.

Comments: This game and its simulations with minor modifications can be used as an operational war game or as a training war game.

TITLE: CASES - Capabilities Assessment Expert System.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Deliberate Planning, Operational Decision Aid, and Analysis.

PROPONENT: Operations Support System (OP-94) and Fleet Planning Center (OP-08). CASES configuration control is managed though Naval Ocean System Center (NOSC code 423).

POINT OF CONTACT: Mr. C. Deleot, CINCPACFLT, Box 3, Bldg 352, Pearl Harbor, HI 96860-7000.

PURPOSE: CASES is a fast running multilevel warplan assessment tool and decision support aid for operations analysts and strategic planners. CASES provides an object oriented modeling environment for warfare planning, tools to help assess the capabilities of forces to conduct their missions according to those plans, and facilities for exploring the benefits of alternate plans by varying initial assumptions (e.g., force composition, threat type/number/characteristics, weather, weapon/sensor effectiveness, and firing doctrine). Each campaign analysis can be stored as an object which can later be recalled and modified to support similar analyses.

DESCRIPTION:

Domain: Sea, air, and undersea. Limited land capability (air strike by Naval and land based aircraft only).

Span: Accommodates all levels of conflict. Actual scale is data base dependent. If data base is not locally available, tools are included in CASES to develop it.

Environment: All movement is determined by relative position and distance between units expanded over time (in days).

Force Composition: Naval component level forces (limited land based air forces), Red and Blue. Modifications are being evaluated to include Joint forces.

Scope of Conflict: All analysis is computed for conventional weapons.

Mission Area: CASES makes use of external models and data bases within a distributed environment. CASES utilizes the best available models for ASW, Environmental, AAW, ASUW, Mine Warfare, Strike Warfare, and Logistics Support.

Level of Detail of Processes and Entities: CASES tracks at the unit level for all forces and weapons. Movement is described by positioning forces iconically. Warfare scenario results are displayed by presenting relative losses, weapons expenditures, logistics requirements and various probabilities of mission success.

CONSTRUCTION:

Human Participation: Required for initial setup only.

Time Processing: Dynamic, event based simulation.

Treatment of Randomness: CASES is a complete Monte Carlo system.

Sidedness: CASES is a two-sided, symmetric model.

LIMITATIONS: CASES currently does not support land warfare analysis.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Following enhancements are expected to be incorporated into CASES by the next release:

1. Enhance the Plan Objects and Planning Functions by adding goals and constraints to plan representation, and search library of campaign objects for similar plans (e.g., goals, constraints, geography, and forces). Provide intelligently constrained replanning and alternative generation.

2. Incorporate C3I constraints and effects for both Red and Blue forces, modified by interactions between warfare mission areas, weather, satellite fly-bys, etc.

3. Add models for Amphibious Warfare, more enhanced ASUW and Mine Warfare, Army mission areas, Air Force mission areas.

4. Extend depth of existing models by providing a richer target typing, include under-ice ASW Ops, and improve the AAW attack profiles.

5. Incorporate "Super Concurrency" technologies to continue reducing run time requirements.

6. Develop a Model Parameter Manager to compare model parameters within and among campaigns, alert the user to potential problems (e.g., out of range values, illogical sets, etc.) in parameter settings, and include the settings in a spreadsheet interface.

INPUT: Campaign setup requires specific identity of Blue and Red forces (including Order-of-Battle, and readiness), general positioning of the forces on a mapping system, target data subset, and both sides strategies expressed across time and in terms of Warfare Mission Areas. Several tools are included in CASES to assist in the setup; these include an Order-of-Battle editor, a targeting editor, and an expert system called OPERA which helps the operator develop Blue ASW Opareas.

OUTPUT: CASES output is initially displayed in a campaign summary sheet which gives event-by-event high level results. The summary sheet gives the operator a quick look at the relative success this particular campaign would have. To analyze variations in segments of this campaign, each event can be brought up in a "Stand-alone" procedure to check inputs versus outputs and run sensitivity ("what-ifs") comparisons. Finally there is an expert system, called ASSESS, which compiles all the data into a final report.

HARDWARE AND SOFTWARE:

Computer(OS):	Navy Standard Desk Top Computer (DTC-II) SUN 4/330 or equivalent with a Supercard and UNIX operating system. The operating system also requires X-Windows and GOTS software to support CASES Man Machine Interface. CASES distributed network software is Cronus, and the Expert systems knowledge base uses Procedural Reasoning System (PRS) and Common-Lisp.
Storage:	2 Gigabytes Storage required (except data base).
Peripherals:	One (1) Color Monitor, One (1) Laser Printer, One (1) UNIX Cassette Tape Drive Unit, and One (1) 8mm Tape Drive Unit.
Language:	Common LISP and C. Associated external models are generally written in FORTRAN, C, or ADA.
Documentation:	System/Segment Design Document (SSDD), CASES User's Manual and Training Materials, Installation and Maintenance Guides, and On-Site Test and Validation Procedures.

SECURITY CLASSIFICATION: CASES is normally operated at the SECRET NOFORN level; however, the classification can be raised to a much higher level (data base dependent) if requirements dictate.

GENERAL DATA:

Data Base: CASES primarily uses standard data bases. The Blue and Red forces characteristics, home ports, Order-of-Battle, weapons loadout, positional data, and readiness reside in a relational data base with initial fill from generic sources (e.g., NWTDB, etc.) and updated with operational and intelligence sources. Targeting data is based on JICPAC target intelligence, and is currently available for 66 PACOM countries.

CPU time per Cycle: Run time varies based on complexity and simulation time duration; however, run time per campaign analysis is usually 15 - 20 minutes. If parallel machines are used, run time can be substantially reduced.

Data Output Analysis: ASSESS is very useful in analyzing the output data. In addition to producing a hardcopy and file of the results of each campaign, ASSESS is tailorable in structure and depth to allow the user to use its output as a final report.

Frequency of Use: Campaign studies are being developed, modified, or analyzed on a daily basis.

Users: CINCPACFLT. By end of 1992, CASES is scheduled to be exported to USCINCPAC, CINCLANTFLT, and CINCUSNAVEUR.

Comments: CASES's models are managed by a Model Review Board to ensure they are viable and up to date; however, each user has an option to replace some or all of the models to meet alternate or special requirements. Model replacement or insertion into CASES can take from 3 to 4 weeks up to six months, depending on complexity.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: CASMO - Combat Analysis Sustainability Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analytical (Logistics).

PROPONENT: USA Concepts and Analysis Agency (CAA), 8120 Woodmont Avenue, Bethesda, MD 20814-2797.

USA Operational Test and Evaluation Command (OPTEC), CSTE-MP, 4501 Ford Avenue, Alexandria, VA 22302-1458.

POINT OF CONTACT: CAA - Dr. Dong Kim, (301) 295-1652, DSN 295. OPTEC, Mr. Richard Lindquist, (703) 756-1688, DSN 289.

PURPOSE: CASMO is used to analyze division level operations of maintenance and logistics support in peace or war time. It is designed to serve as both an operations support and a capability assessment of major weapon systems to meet mission requirements.

DESCRIPTION: CASMO is a stochastic, event-step simulation model representing the operation of maintenance and logistic support within Army Divisions. CASMO is designed to assess the capability of U.S. Army combat units and their supporting maintenance and logistics organizations to: (1) maintain and repair weapon systems, (2) reorder spare parts, and (3) perform other maintenance and logistics support functions under a variety of operational environments.

Domain: Land.

Span: Accommodates any division in a theater depending on data base.

Environment: Cartesian Coordinate based, all terrain. Models shifts in day and night, peace and war time, combat postures.

Force Composition: Any type of division, Blue and Red.

Scope of Conflict: Conventional warfare, conventional weapons excluding fixed wing aircraft for maintenance repair.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Models company level, resolution to bumper number of weapon systems, man-hours of MOS, service equipment and spare parts by NSN, fuel in gallons, ammunition in rounds.

CONSTRUCTION:

Human Participation: Human participation is not required during simulation. Decisions are made at input.

Time Processing: Dynamic, time- and event-step model. Progress through events during a given combat cycle time period.

Treatment of Randomness: Scheduled and unscheduled maintenance requirements are randomly selected at each failure. All vehicles have assigned bumper numbers and vehicles are assigned for maintenance by random selection of bumper numbers. Selection of damaged part for combat maintenance is a random process. CASMO uses delay distribution for several types of time delays. Time delays range from deterministic delays to stochastic delays and include most of the traditional probability distributions. These are Deterministic, Exponential, Uniform, Normal, Log-normal, Gammer, Weibull and Empirical distributions.

Sidedness: Two-sided but operations of logistics supports for only the blue side.

LIMITATIONS: Fixed wing aircraft weapon system is not modeled. Attrition of maintenance system and repair personnel are not modeled. Supply trucks are not modeled, though delay distributions are used.

PLANNED IMPROVEMENT AND MODIFICATIONS: Rotary wing weapon system (Helicopters) will be modeled.

INPUT: CASMO requires three categories of input data to complete sustainability analysis. These are: (1) scenario data that include weapons and ammunition to be modeled, combat unit and maintenance unit organization, and resources of maintenance unit, (2) unit action data that define battery or company maneuvers and combat action during the simulated engagements, and (3) combat damage data that determine how many combat " hits" each blue weapon system receives. Combat damage data is combined with shot line data derived from the Sustainability Prediction for Army Spare Components Requirements for Combat (SPARC) to generate a list of parts damaged for repair.

OUTPUT: CASMO produces two types of outputs including a summary report and a detailed historical event file. The summary report contains two categories of information, namely, queuing statistics and maintenance resources utilization statistics. The summary report is designed to present summary information useful to three types of users: (1) a maintenance decision maker, (2) a supply decision maker, and (3) an operational decision maker. The summary report contains MOS utilization per shift, maintenance throughput, utilization of equipment/recovery vehicle/contact vehicle, deferred maintenance actions, parts status, number of back orders, fuel/ammunition supply data, number of type weapon systems down, and availability of weapon systems.

HARDWARE AND SOFTWARE:
Computer(OS): VAX 11/780, VAX 8600 (VMS).
Storage: 6 M-bytes.
Language: SIMSCRIPT, FORTRAN.
Documentation: Analyst Guide,User Training Manual. (Adequately documented).

SECURITY CLASSIFICATION: Programs are unclassified, input data are classified.

GENERAL DATA:
Data Base: Data base must be developed for type of weapon systems modeled. Once the data base has been developed, a large portion of data may not need to be changed for each study unless there is a need to model a new weapon system.

Time Requirements: 24 weeks (for preparation, run and analysis).

Frequency of Use: Plans 2 studies per year.

Users: Operational Test and Evaluation Command, U.S. Army Concepts Analysis Agency

TITLE: CASTFOREM - Combat Arms Task Force Engagement Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: TRADOC Analysis Command, White Sands Missile Range (TRAC-WSMR), White Sands Missile Range, NM 88002-5502.

POINT OF CONTACT: C. Denney, (505) 678-1881, AV 258-1881.

PURPOSE: CASTFOREM is used for weapon system and tactics evaluation in brigade and below combined arms conflicts.

DESCRIPTION:

Domain: Combined arms ground conflicts (support helicopters, limited fixed-wing and air defense, and dismounted fire teams).

Span: Extremely flexible; can accommodate any terrain or weapon system for which data is available.

Environment: Uses digitized terrain data. Weather and ambient light conditions are constant throughout the battle. Battlefield obscurants, smoke, and dust are modeled as dynamic clouds.

Force Composition: Combined arms, normally battalion or brigade--equal representation for RED and BLUE.

Scope of Conflict: Conventional warfare with limited chemical and nuclear effects. Directed energy weapons, including lasers and high-powered microwave are modeled.

Mission Area: Primarily intended to model intense Battalion-level battles up to one hour in length.

Level of Detail of Processes and Entities: Very high resolution for conventional and directed energy weapon system with resolution to the item system level. Processes are modeled probabilistically using Monte Carlo techniques.

CONSTRUCTION:

Human Participation: Required for preparing the decision rules set prior to running the model.

Time Processing: The model is event sequenced. Time-step events are possible.

Treatment of Randomness: All events including probability of detection, probability of hit, and probability of kill are stochastic. Line of sight is deterministic.

Sidedness: Two-sided, symmetric treatment. An Expert System combat model.

LIMITATIONS: RAM is not explicitly modeled. Fixed-wing air-to-air is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: High-resolution dismounted combat is to be added. Automated inputs from graphics workstations are planned.

INPUT: Voluminous inputs required, including digitized terrain, unit organization, weapon systems performance, sensors, vulnerability data, communications nets, and decision tables to affect each scenario.

OUTPUT: History tape to be postprocessed to yield both statistical and graphical outputs.

HARDWARE AND SOFTWARE:

Computer(OS): VAX Series using VMS, Univac 1100/92 using EXEC, SUN III workstation, Hewlett Packard 9000/800 series, and SUN IV workstation.

Storage: Efficient operation calls for at least 8 MB of RAM and 100 MB of MASS storage.

Peripherals: MASS storage is required while printers and plotters are very convenient. For graphical playback, RAMTEK 9400 series are used.

Language: SIMSCRIPT II.5.

Documentation: Executive Summary, Methodologies Manual, Users Input Guide, Scenario Writing Guide, and Post Processor Users Guide are available through Defense Technical Information Center.

SECURITY CLASSIFICATION: Model code is unclassified; certain data is classified up to Secret.

GENERAL DATA: Output is generally unclassified.

Data Base: Developing a data base for a new scenario is scenario dependent but generally is three to six months.

CPU time per Cycle: Scenario dependent and machine dependent. Average battalion and brigade scenarios run 1 1/2 hour on VAX 8800.

Data Output Analysis: One to three weeks.

Frequency of Use: Daily.

Users: U.S. Army TRAC-WSMR, Picatinny Arsenal, Survivability Management Office, MICOM, Harry Diamond Labs, and Contractor RAM Inc.

Comments: Configuration control policies call for each user to belong to the CASTFOREM user group. A reference version is maintained by TRAC-WSMR. Model release policies are in place and managed by TRADOC Analysis Command, Requirements Program Directorate.

TITLE: CBAM - Combat Base Assessment Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Air Base Operability SMO (ASD/YQ), HQ ASD Eglin AFB, FL 32542.

POINT OF CONTACT: Mr. Bob Hume, YQE, AV 872-9113, Commercial (904) 882-9113.

PURPOSE: The model relates Air Base performance, primarily in terms of aircraft sorties generated, to Air Base operations in response to Red attack scenarios. In a generalized scenario it can be used as a Research and Evaluation tool or with base specific information it could be used as an Operation Support Tool.

DESCRIPTION:
Domain: Land and air around an air base.

Span: Individual air base.

Environment: Detailed scale layout of air base (2D representation) including weather and time of day.

Force Composition: Red air and ground attack forces vs. base facilities and blue mission aircraft. Has point air defenses against red air forces with air defense effectiveness reports. Has air base ground defense teams and sensors that respond to ground attacks and airborne assaults. Does not do air to air engagements.

Scope of Conflict: Red weapons include air to ground conventional and chemical munitions, missile delivered conventional and chemical warheads, ground based SAMs, Spetsnaz delivered charges and RPGs and airborne forces. Blue weapons are limited to AAA guns, ground to air SAMs and Security Police defenses.

Mission Area: Base recovery and sortie generation.

Level of Detail of Processes and Entities: Individual entities are modeled; i.e., aircraft, buildings, equipment, critical personnel and resources as opposed to groups or organizations. Only one air base is modeled at a time. Individual events are tallied and can be displayed as graphs after the simulation is completed. Most activities are modeled as fixed time delays.

CONSTRUCTION:
Human Participation: Is not allowed during the running of the simulation. The setup of the scenarios is very interactive and provides feedback during layout and attack designs.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic with a mixture of expected value functions, counting of deterministic events and queues, and random number generators with fixed seed streams.

Sidedness: Two-sided - red attack on blue facilities. Asymmetric--different functions are modeled for each side. One side nonreactive--red attacks are user inputs; blue reaction is simulated by the model.

LIMITATIONS: Capacity is limited by computer memory rather than by model design. 2D representation of facilities. Cookie cutter damage functions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of fire fighting capability and its effect on sortie generation.

HARDWARE AND SOFTWARE:

Computer OS: MSDOS/PC-AT compatible (Z-248 and UNISYS DT III tested).
Storage: 2Meg RAM, 20Meg Hard drive as minimums.
Peripherals: EGA graphics, dot matrix printer, color plotter and mouse.
Language: C.
Documentation: User's manual and analyst manual (Draft copies).

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Generating valid base specific data could be time consuming. Entry of data is simple filling in of the blanks. Modifying data bases is very simple.

CPU time per Cycle: Very scenario dependent, a few minutes to a half an hour.

Data Output Analysis: Graphs of predefined data sets can be plotted in minutes. An event calendar plus input and output data bases can be searched using dbase compatible programs. Preformatted reports of damage, air defense and aircraft activities can be printed quickly.

Frequency of Use: Model is being used on a daily basis to support studies and operational exercises.

Users: Hq PACAF, ASD/YQE, Engineering Services Center (ESC), Field Command Defense Nuclear Agency (FCDNA), and the Naval Civil Engineering Laboratory (NCEL).

Comments: Completion of the model is expected in late FY92.

TITLE: CBS - Corps Battle Simulation, Version 1.3.5; formerly known as Joint Exercise Support System (JESS).

DATE IMPLEMENTED: 1985.

MODEL TYPE: Training wargame.

PROPONENT: U.S. Army Program Manager, Training Devices (PM TRADE), Orlando, FL.

POINT OF CONTACT: PM TRADE, P. Spangler, Project Director (407) 380-4309; Combined Arms Command-Training (CAC-T) Fort Leavenworth, CPT H. Lee, CBS Project Development Officer (913) 684-3180.

PURPOSE: CBS is the Corps/Division command and staff trainer in the Army's Family of Simulations (FAMSIM). Its primary use is as a CPX driver. It is used by the Battle Command Training Program (BCTP) and by the corps to train corps, division, and brigade staffs. CBS is also used by BCTP as a seminar trainer.

DESCRIPTION:

Domain: Land and air combined arms combat.

Span: Corps Area of Operations.

Environment: Hex based terrain features. Terrain is characterized by terrain type, elevation, roughness, vegetation, urbanization, roads, rivers, bridges, obstacles, and fortifications. Models day, night, and some weather effects.

Force Composition: Combined land and air forces.

Scope of Conflict: Both Blue and OPFOR conventional, chemical, rear-area, deep, and nuclear play.

Mission Area: All elements of air-land battle including conventional and tactical nuclear combined arms warfare, indirect fire, close air support, battlefield air interdiction, airlift, maintenance, logistics, and medical operations.

Level of Detail of Processes and Entities: Ground representation generally to battalion level, but specialized units at platoon level and below. Air units to individual aircraft. Indirect fires are explicit. Air defense is modeled. Terrain effects and congestion affect ground movement. Air missions modeled include CAS, BAI, OAS, DCA, and CAP. Direct fire combat results are determined by use of weapon-on-weapon Lanchester attrition calculations, supplemented by the expert system, Combat Outcome Based on Rules for Attrition (COBRA). COBRA uses artificial intelligence to provide accurate combat results in a wide variety of combat situations without introducing excessive complexity into the model.

CONSTRUCTION:

Human Participation: Required, except when running from a previously generated orders file.

Time Processing: Dynamic, event-step. Runs at multiples of wall clock time.

Treatment of Randomness: Lanchester attrition may be deterministic or stochastic, Monte Carlo. Other random events are stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric, except for some opposing forces functions, such as logistics, which are partially automated.

LIMITATIONS: Currently limited to approximately 5000 units, depending on speed of computer used. No current smoke representation, currently no special operations, no naval or amphibious play.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Special operations, smoke, laser guided munitions, and enhanced user interface additions, including Air War Simulation (AWSIMS) link, currently underway. Expected completion date is December 1992.

INPUT: Terrain, forces, weapons characteristics, close combat data, and other inputs are [illegible] into the data base. Current data bases provide data sets for Europe, Central America, Southwest Asia, and Korea. During simulation, controllers input orders and requests for information by using VAX VT220 terminals and digitizing pads in conjunction with color video display terminals (VDTs).

OUTPUT: Military graphics overlaid on variable scale maps displayed on color VDTs. Orders, spot reports, and other output for controllers and training audience are output on dot matrix printers and to files for data reduction. Postprocessing is possible on files which store the basis for combat results. Stand-alone After Action Reporting (AAR) system under development by BCTP.

HARDWARE AND SOFTWARE:

Computer:	A network of one central processor (such as VAX 6420) and several (depending on number of controllers) Micro VAX II computers using the VAX VMS operating system.
Storage:	The central processor requires 128 megabytes RAM and each Micro VAX requires 16 megabytes RAM. The mass storage requirements on each processor will vary depending on the data base used, but generally 150 megabytes of hard disk storage is required at the central processor and 50 megabytes at each Micro VAX.
Peripherals:	VT220 terminals, color VDTs, video disk players, graphover video overlay systems, digitizing pads, and dot matrix printers.
Language:	SIMSCRIPT II.5, C, OPS 5 expert system language.
Documentation:	Nineteen volumes of published documentation. Includes User's Handbooks, Analyst's Guides, Design Documents, etc.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Collection and entry of complete data base set would take several man-years. Moderate changes to force structure would typically take several man-weeks.

CPU time per Cycle: Intended to run at 1:1 ratio to provide realistic training. Can be adjusted to run at much higher speeds.

Data Output Analysis: Utility data reduction programs available to determine reasons for combat outcome and to provide analysis of spot reports and orders. AAR system under development by BCTP.

Frequency of Use: Over 100 times per year.

Users: I Corps, III Corps, V Corps, VII Corps, XVIII Corps, National Simulation Center, BCTP, CENTCOM, USACGSC.

Comments: Model is under configuration management. Administrative manager is PM-TRADE. Technical manager is CAC-T. Version 1.3.5 is currently fielded. Version 1.4 will be delivered in December 1992.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: CCBM - Generic Crew-Centered Bomber Mission Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: AAMRL/HE, Wright-Patterson AFB, OH 45433-6503.

POINT OF CONTACT: Dr. Robert G. Mills, (513) 255-7588, AV 785-7588.

PURPOSE: CCBM is a research and evaluation tool used to investigate individual and crew performance. It can also be used as an operation support tool (decision aid) to examine information flow and requirements, individual and crew workload, crew sizing, crew procedures, situational awareness, and predicted impact of system changes upon mission performance.

DESCRIPTION:
Domain: Air.

Span: Local.

Environment: Defined by the user as a function of bomber mission. The model does not currently have terrain or weather capabilities.

Force Composition: Crew performance of individual bomber crew members can be modeled.

Scope of Conflict: Dependent upon user's problem and model development.

Mission Area: Dependent upon user's problem and model development.

Level of Detail of Processes and Entities: Lowest entity modeled is individual crew members' tasks. Processes are dependent upon user's problem and model development.

CONSTRUCTION:
Human Participation: Human participation is required for model development. The user can specify a time segment during which the model will collect snapshot data during execution.

Time Processing: Dynamic, time-step and event-step, and closed form.

Treatment of Randomness: Stochastic, based on direct computation with Monte Carlo used in the simulation of sensor effectiveness and the ability to degrade offensive and defensive systems performance.

Sidedness: One-sided.

LIMITATIONS: CCBM currently has low-level penetration and target acquisition segments. Terrain and weather are not included.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Weapon delivery and egress segment are planned in the next effort beginning April 1989. Offensive systems, terrain, and weather will also be included. A follow-on effort will complete the model from takeoff to landing including refueling.

INPUT: Crew member task performance parameters, scenario and avionics parameters, weapons configuration, threats, and targets (e.g., relocatable).

OUTPUT: Computer printouts, raw data, and statistical analyses of crew member task performance parameters; mission performance data such as targets acquired, etc.; and avionics parameters such as distance from waypoints and time of arrival of waypoints along with weapons configuration, threat, and target information.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system that includes Screen Management facility.
Storage:	529 blocks (270.8 KB) needed before data bases are created.
Peripherals:	VT-100 or compatible terminal.
Language:	FORTRAN.
Documentation:	Technical documentation is available; there are no DDC accession numbers.

SECURITY CLASSIFICATION: Unclassified without a given problem, structure parameters, and data. CCBM is an unclassified computer simulation model.

GENERAL DATA:

Data Base: Creation of the data base is interactive, with the user utilizing a human-computer interface to help with inputting the physical and crew function files.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: CCBM has recently become available for field application. Aside from AAMRL, there are currently no other users.

Comments: Model segments are linked in a way that permits execution of individual segments. For example, a target acquisition segment can be executed without low-level penetration. CCBM's structure consists of individual modules that provide model development flexibility in that an entire model does not have to be recoded in order to be modified. The user needs to modify only those modules that are affected.

TITLE: CCDECSIM - Close Combat Discrete Events Controlled Simulation.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: BGWG Section, CA4 Division, RARDE, Fort Halstead, Kent, England.

POINT OF CONTACT: Mrs. J. Saunders, (PO/BGWG CA4) RARDE, Fort Halstead, Kent, England. Tele: U.K. 0959-32222, Extension 2924.

PURPOSE: The game/simulation is being developed to provide a facility to evaluate and compare the effectiveness of small arms. It will be able to run as either a Wargame or a Simulation. CCDECSIM is still under development.

DESCRIPTION:
Domain: Land (and later Land/Air).

Span: Local.

Environment: Digitized terrain consists of data for each 10 metre square. Terrain features include spot heights, types of vegetation and buildings, rivers, roads, bridges, and obstacles.

Force Composition: Up to Company level.

Scope of Conflict: Conventional.

Mission Area: Direct Fire Battle (up to 5km front).

Level of Detail of Processes and Detail: The lowest entities modeled are individual men, vehicles or aircraft. Attrition, movement, target acquisition and logistics are modeled for each entity.

CONSTRUCTION:
Human Participation: Required for decisions in the Wargame, though the model would continue to run without a decision.

Time Processing: Processing is dynamic, the model uses event-stepping.

Treatment of Randomness: The model is stochastic, it uses the Monte Carlo method.

Sidedness: The model is two-sided and symmetric.

LIMITATIONS: Does not model C3I in any detail. Indirect fire, obscuration and minefields are modeled relatively crudely. As yet the model cannot represent helicopters (there is no intention of representing fixed-wing aircraft).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Phase 1 of the model has not yet been fully implemented. There are many improvements planned for this and subsequent phases of the model including: a night model, helicopters, and an urban model.

INPUT: Terrain data, system and weapon characteristics including attrition data, mobility data and activity timings, sensor data. smoke and dust data.

OUTPUT: A detailed log of all events will be maintained.

HARDWARE AND SOFTWARE:

Computer:	2 VAX station 3100 systems (GPX VAX Station compatible).
Storage:	100 megabytes minimum.
Peripherals:	TK50 tape drive; Storage expansion box and printer.
Language:	VWS VAX windowing software and PASCAL.
Documentation:	There is a beginner's guide, but a full user's guide has not yet been produced.

SECURITY CLASSIFICATION: Unclassified, data base classified Secret.

GENERAL DATA:

Users: BGWG section, CA4 Division in response to requests for studies by a series by a series sponsor from within the M.O.D.

Comments: No study has been run using CCDECSIM; therefore, any areas such as frequency of use are still unknown.

TITLE: CCOMEM - Conventional Collateral Mission Effectiveness Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis Organization, P.O. Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: Joetta C. Mark (316) 526-2810.

PURPOSE: The CCOMEM model evaluates aircraft capability against naval and land surface forces. It is a Monte Carlo computer simulation used in campaign mission effectiveness studies. It determines outcomes of multiple offense and defense encounters during the attack phase of a mission. The primary campaign roles of CCOMEM are antishipping and antimobile land scenarios in which a coastal region of army and naval forces is under air attack. Defensive engagements from the land and surface elements and offensive engagements from the attacking aircraft are modeled with respect to the user scenario.

DESCRIPTION:

Domain: Air, land, and sea.

Span: The model is used in campaign mission effectiveness studies and analyses of air attacks on land and surface forces.

Environment: Statistical terrain features based on typical DMA data. The data is used to generate line-of-sight statistics as a function of azimuth and altitude, then a Monte Carlo randomization determines whether target acquisition is possible.

Force Composition: Two-sided. RED on BLUE or BLUE on RED. Various aircraft types, AIs SAMS, AAA, ships, tanks, trucks, etc.

Scope of Conflict: Conventional weapons include air-to-air and air-to-ground missiles, SAMs, and AAA. No nuclear or chemical effects are considered.

Mission Area: Aircraft effectiveness studies, antishipping and antimobile land element campaigns, and conventional standoff and attack capability analysis.

Level of Detail of Processes and Entities: Movement is modeled for each individual player, including attacking airborne platforms (bombers and fighters), AIs, SAMs, AAA, tanks, trucks, and ships. The initial position, turn points or heading, and altitude and speed determine the successive positions of each offensive and defensive element that may take part in the scenario. The numbers of players may be from one-on-one to many-on-many. The defensive and offensive capabilities are used to control detection ranges, weapon launch ranges, hit and kill probabilities, and maneuvers. Encounters between various offensive and defensive elements are evaluated individually, using Monte Carlo techniques.

CONSTRUCTION:

Human Participation: Required for input data base preparation and planning only. After execution begins, human participation is not normally allowed.

Time Processing: Dynamic, event-driven.

Treatment of Randomness: Monte Carlo determination of player encounters and detections based on input probabilities.

Sidedness: Two-sided, asymmetric. The attacking aircraft are modeled at a higher level of fidelity than defensive elements.

LIMITATIONS: Does not simulate missile flyout. All players must be mobile. All ships within a sailing formation must have the same velocity. The model has no capability for defenses against deck launched AIs.

PLANNED IMPROVEMENTS AND MODIFICATIONS:

INPUT: Aircraft Sorties (if fixed flight), weapon loading and launch parameters, basic movement parameters for all players, detection contours, attack priorities, and probability of kill data.

OUTPUT: Attacker attrition, target kill statistics, position information for subsequent graphics analysis, and complete time-ordered event trace.

HARDWARE AND SOFTWARE:

Computer:	APOLLO Workstation with DOMAIN IX operating system (Previously executed on VAX 11/780 computer with VMS).
Storage:	475K bytes, including input files.
Peripherals:	None necessary. One printer if hardcopy is desired. Graphical terminal for animated playback with plotter for hardcopy.
Language:	FORTRAN IV and FORTRAN 77.
Documentation:	User's manual that is not completely current with model updates. Boeing Document Number: D500-10197-1.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Mission planning and scenario development normally requires several weeks. Tabular data may take several months to collect or generate.

CPU time per Cycle: Dependent on data base size and numbers of players. A typical scenario can take several hours.

Data Output Analysis: Results take little time to analyze but may lead to more model executions.

Frequency of Use: Varies by priority and requirements; has not been used extensively since 1986.

Users: BMA, Operations Analysis.

Comments: N/A.

TITLE: CECOM Center for C3 Systems System Performance Facilities.

DATE IMPLEMENTED: 1985 - present.

MODEL TYPE: Communications System Performance Analysis.

PROPONENT: CECOM Center for C3 Systems, Modeling and Simulation Branch, Ft. Monmouth, NJ 07703.

POINT OF CONTACT: William Sudnikovich, DSN 995-2119; Comm (908) 544-2119.

PURPOSE: Models and simulations to support detailed engineering system performance analysis of major Army communications systems (MSE, SINCGARS, EPLRS). Also, integration efforts in progress to provide communications analysis support to existing Fire Support and Air Defense models.

DESCRIPTION:
Domain: Ground Based Communications Assets, Ground and Airborne Electronic Threat Analysis.

Span: Supports analysis for scenarios comprising Corps area communications requirements and below.

Environment: Uses Defense Mapping Agency (DMA) Digital Terrain Elevation Data (DTED) data for computing propagation losses on RF communications links. Models also account for Electromagnetic Interference from unfriendly emitters.

Force Composition: Physical components of communications hardware (Red and Blue) are modeled. User requirements are extracted from the Communications Data base (CDB), which is supported by the U.S. Army Signal Center, to support the scenario under analysis.

Scope of Conflict: N/A.

Mission Area: Communications Systems.

Level of Detail of Processes and Entities:

CONSTRUCTION:
Human Participation: Required for building scenarios and simulation parameter setup. No human interaction during simulation runs.

Time Processing: Simulations are processed using discrete event scripts which detail the actions required at specific simulation times. The processing requirements for any simulation run are deployment and scenario dependent.

Treatment of Randomness: Physical hardware is modeled t em specifications. Any randomness is reflected as specified i system documents. User communications requirements are generally mo ed using some statistical message generation distributions based on Army supported communications requirements data bases.

Sidedness: N/A.

LIMITATIONS: Models and simulations as they exist were built to perform analysis for specific customers. Any limitations of this suite of models and simulations are a result of their intended purpose. The models are, however, built in a modular hierarchy of independent sub-models representing physical components of systems. This modularity allows flexibility in current analysis and accommodates the addition of requirements in a cost-effective manner.

PLANNED IMPROVEMENTS AND MODIFICATIONS: All models in the C3 Systems, System Performance Facility suite of models are updated and modified as necessary to reflect updated system specifications and customer requirements for analysis.

INPUT: Depending on the system simulated for analysis, input parameters include but are not restricted to: Radio (detailed) characteristics, Antenna Patterns and Signal Characteristics, Circuit/Packet Switching Message Processing Delays, Network Connectivity Requirements, Voice/Data Traffic Requirements

OUTPUT: Statistics detailing performance characteristics of the systems under analysis are output to files that can be used by any commercial data base or statistical analysis package.

HARDWARE AND SOFTWARE:

Computer:	Digital Equipment Corp. VAX/VMS Systems.
Storage:	Model Dependent, Recommended Minimum 16MB RAM and 200MB Hard Disk.
Peripherals:	Graphics Printer/Plotter.
Language:	General Simulation System (GSS).

SECURITY CLASSIFICATION: The models are unclassified, but C3 Systems facilities are accredited to process data file with these models up to the Secret level.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: Data output analysis is not provided by the models themselves. All output is formatted into data base tables and is made available for the analyst to use any statistical package appropriate for the intended analysis.

Frequency of Use: Project dependent.

Users: CECOM Center for C3 Systems, PM Mobile Subscriber Equipment (MSE), Vulnerability Assessment Labs (VAL), CECOM Architectural Engineering Directorate (AED), PM Army Data Distribution System (ADDS), PM Guardrail, PM Advanced Field Artillery Tactical Data System (AFATDS).

Comments: The CECOM Center for C3 Systems previously only supported system performance models of the Mobile Subscriber System. This submission to the J8 Catalogue should reflect the on-going development and applicability to all major Army communications systems and the interface possibilities to Battlefield Automated Systems for detailed communications system performance predictions.

TITLE: CEM - Concepts Evaluation Model.

DATE IMPLEMENTED: 1974.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: William T. Allison, (DSN) 295-5236 or (301) 295-5236.

PURPOSE: CEM is used primarily to analyze force effectiveness at theater level warfare. It is designed to provide a tool to assess the effectiveness of different mixes of forces and resources and to estimate ammunition, equipment, and personnel requirements.

DESCRIPTION:

Domain: Land and air.

Span: Accommodates any theater given a data base; has been used for Korea, Southwest Asia, and Central Europe.

Environment: Terrain consists of three types representing good cross country maneuverability, marginal cross country maneuverability and road bound. Natural and man-made barriers are also represented. Terrain is described in rectangular bands. Each 12-hour division level cycle represents average proportion of day and night. No weather.

Force Composition: Combined forces for Blue and Red.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional missions except unconventional warfare.

Level of Detail of Process and Entities: Simulates command decisions at four levels from theater to division. Force inputs as Blue brigade and Red division. Combat occurs between Red divisions and Blue brigades along a continuous FEBA. Accommodates up to 70 Blue and 125 Red divisions with up to 51 types of weapons. Aircraft are aggregated into two types; Air Defense Fighters and Tactical Fighters. The latter are given daily missions of Counter Air (CA), Armed Recon/Interdiction (AR/I), or Close Air Support (CAS). Attrition to CA and AR/I are probability of kill. Attrition to CAS and divisional personnel and equipment is derived from results of a high resolution simulation used to extrapolate for the actual weapons in the CEM engagements. Logistics are highly aggregated. Movement of FEBA is a function of attacker and defender final to initial combat worth ratios.

CONSTRUCTION:

Human Participation: None. Fully automated.

Treatment of Randomness: A deterministic combat simulation.

Time Processing: Time-step based on a 12-hour division level cycle.

Sidedness: Two-sided, symmetric model.

LIMITATIONS: Does not model breakthrough, airborne assaults, engineer functions, transportation, lines of communication, electronic, chemical, or nuclear warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Different combat attrition samples for night and day; deep fires against second echelon and arriving forces; combat attrition of GS artillery.

INPUT: Terrain map; troop lists; TOEs (personnel, ammo, POL, other supplies, tanks, APCs, helicopters, anti-tank missiles, and artillery); shooter-target results from high resolution simulation; resupply and replacement rates (personnel, ammo, POL, other supplies, and weapons); arrival schedule for resupply, reinforcing artillery battalions, and maneuver units; and FEBA movement tables.

OUTPUT: Computer reports stating (periodic) FEBA locations, posture profiles, state of opposing forces, resources expended, KIA, WIA, CMIA, and DNBI; and weapons hit, destroyed, damaged, abandoned, and repaired. Graphic (plotter or color CRT) display of same results.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1100/84; CRAY XM-P/48; CRAY 2.
Storage:	1.2 million decimal words.
Peripherals:	Two tape drives or disks; one printer.
Language:	ASCII FORTRAN.
Documentation:	CAA-D-85-1, Volume I, Technical Description, January 1985 (Revised October 1987); CAA-D-85-1, Volume II, Users' Handbook, August 1985. (Revised January 1990).

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Acquisition - 2 months; Preparation - 18 man-months.

CPU time per Cycle: UNISYS 1100/84 - 36 hours (for 180 days simulation); CRAY XM-P/48-4 hours (for 180 days simulation).

Data Output Analysis: 2 months.

Frequency of Use: 800 timer per year.

User(s): U.S. Army Concepts Analysis Agency.

Comments: CEM is dependent on results from a higher-resolution division model (presently COSAGE) for combat attrition and munitions expenditures.

TITLE: CFARC - Cloud Free Arc Simulator.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: United States Air Force Environmental Technical Applications Center (USAFETAC), Environmental Simulation Section. USAFETAC/DNY, Scott AFB IL 62225-5438.

POINT OF CONTACT: Capt Anthony J. Warren, DSN 576-5412, Commercial (618) 256-5412.

PURPOSE: This model performs sensitivity analyses of potential ground-based laser sites by generating downtime statistics; i.e., duration of cloud of conditions along a line-of-sight from the ground to an orbiting satellite. Downtime statistics can be accumulated for a system of 1 to 25 sites.

DESCRIPTION:

Domain: Surface-to-orbiting satellite. Mobile surface sites (e.g., ships) are permitted.

Span: Global.

Environment: CFARC is an environmental model.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: CFARC produces downtime statistics for systems for systems of 1 to 25 sites. Model determines individual locations as well as all possible combinations of sites. Seasonal and diurnal effects can be evaluated with this model.

CONSTRUCTION:

Human Participation: None.

Time Processing: Dynamic, time-stepped model.

Treatment of Randomness: Stochastic, Monte Carlo. The four-dimensional Boehm Sawtooth Wave model is used to generate fields of spatial and temporally correlated random numbers.

Sidedness: One-sided.

LIMITATIONS: Maximum of 25 surface sites can be tested simultaneously. Terrain obstructions are not modeled. Satellite orbit must be sufficiently high (fast-orbiting satellites cannot be accounted for with CFARC).

PLANNED IMPROVEMENTS AND MODIFICATIONS: The USAFETAC model CLDGEN (Cloud Scene Generator) can be used for system with a low satellite orbit.

INPUT: Parameters of the Burger Aerial Algorithm, used to model the cloud-cover distribution. There are two parameters (mean cloud-cover and scale distance) for each hour of the day, by month. A set of these coefficients is needed for each site.

OUTPUT: Downtime duration statistics are accumulated in user-defined time categories for a system of ground sites.

HARDWARE AND SOFTWARE:

Computer (OS):	Designed on an IBM mainframe using the MVS operating system, but written in ANSI-Standard FORTRAN specifically to enhance portability to other computers and operating systems.
Storage:	70 Kilobytes.
Peripherals:	None required.
Language:	ANSI-Standard FORTRAN 77.
Documentation:	USAFETAC/PR-86/002, Cloud-Free Line-of-Sight (CFLOS) Simulation Models Users Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Model coefficients are prepared by USAFETAC. Processing time is minimal.

CPU time per Cycle: Dependent upon the number of locations and the desired time-step. A one-year simulation for 25 sites requires 3.6 seconds.

Data Output Analysis: N/A.

Frequency of Use: Unknown.

Users: Phillips Laboratory, Air Force Weapons Laboratory, Det 50, 2 WS (Onizuka AFB).

Comments: None.

TITLE: CFAW - Contingency Force Analysis Wargame.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Mr. Robert Hart, (DSN) 295-1574 or (301) 295-1574.

PURPOSE: CFAW is used primarily to examine both operation plans and contingency plans and to analyze potential conflict.

DESCRIPTION:

Domain: Land, air, and over-the-shore naval operations.

Span: Scale depends on specific study needs. Reasonable span ranges from division to small theater.

Environment: Hex-based. Each hex edge incorporates 1 of 10 possible types of road and off-road trafficability factors. Each hex is one of seven terrain types, which include mountains, hills, null, flat, swamp, urban, and water. Hex size is an input parameter; the current model can employ four 49x49-hex maps. Weather, time of day, and day and night are modeled.

Force Composition: Combined and joint forces can be modeled.

Scope of Conflict: Conventional conflict with rear area and noncontiguous FLOT. Nuclear and chemical play is limited to initial effects (no effects of contamination, persistence, collateral damage, etc.).

Mission Area: Air (DCA, CAS, BAI), direct and indirect fire (including TBM and rockets), air defense, airlift (including airborne and airmobile), and barrier operations are represented.

Level of Detail of Processes and Entities: Land combat units can be modeled from company to division as discrete entities with brigade/regiment being the preferred entity size. Units are collections of direct and indirect fire weapon types, each having a descriptive data base of acquisition and kill probabilities, fire distribution, and other input parameters. Attrition on units in direct fire combat is adjudicated by a differential equation. Equation parameters are obtained from a detailed, Monte Carlo simulation model. Attrition varies with posture and terrain. Combat is initiated by attack by an aggressor unit and terminated upon player command or by breaching a player specified attrition threshold. Model is a single echelon command and control; players must give orders to each unit played for movement. Air units are modeled as squadrons of individual aircraft that can be given ground attack, defensive counter-air, or escort missions.

CONSTRUCTION:

Human Participation: Required for all unit mission and movement decisions.

Time Processing: Dynamic, time-step. Game time to real time is variable.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Unreproducible results due to stochastic randomness and player variabilities. Altitude is not played, which degrades air defense fidelity. Player span of control limits practical number of entities per side to approximately 100. Player decision variability does not permit replication of a specific game. Small unit combat, to include SOF-type activities, is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhanced logistics effects and improved ability to divert air missions to immediate targets.

INPUT: Units: weapon counts, ground speed, supply consumption rates, indirect fire damage capability and range, unit size, and designation. Scenario: terrain description. Attrition: individual weapons data, terrain effects on weapon densities, probabilities of detection and kill for each weapon target pairing, expected aircraft specific exchange ratios, and air defense effectiveness. Game: initial map position and arrival time for each unit played.

OUTPUT: Current status (strength, position, and activity) and map picture of playing screen as desired during game. Strengths over time of weapons by location, activity, type, etc., as desired by analyst in tables and charts.

HARDWARE AND SOFTWARE:
- Computer(OS): VAX 780 with VM
- Storage: 100 words.
- Peripherals: Five DEC VT102 terminals, three Ramtek RGB monitors with driver, one printer.
- Language: FORTRAN
- Documentation: Under development.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:
Data Base: One to three weeks (given information availability).

CPU time per Cycle: Approximately 20 minutes of each gaming hour.

Data Output Analysis: Postprocessor/analytical aids, hardcopy, order streams.

Frequency of Use: Six to eight different war game scenarios per year.

User(s): USACAA operates war game for DA Staff, Army agencies, and major commands.

Comments: USACAA performs configuration control, model improvements, and maintenance.

TITLE: CFTR - Chirp Filter Transfer Response.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze filter response to ECM.

INPUT: Filter characteristic data, amplitude and phase measurements. ECM signal parameters (frequency, pulse, CW, etc.).

OUTPUT: Plots of filter and signals in frequency and time domains.

HARDWARE AND SOFTWARE:
- Computer: DEC VAX. Requires array processor.
- Storage: 100K Bytes; memory requirements: 2M Bytes.
- Language: VAX FORTRAN.
- Documentation: None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
- Data Base: Preparation time is 3 hours.
- CPU time per Cycle: 2 minutes on VAX Computer.
- Comments: Status of Model - completed; debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: CHAS - Chemical Hazard Assessment System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: AL/CFHD, Wright-Patterson Air Force Base, OH 45433-6573.

POINT OF CONTACT: Dr. C.R. Replogle, DSN 785-7583, Commercial (513) 255-7583.

PURPOSE: CHAS was developed in support of the SALTY CHASE Command Post Exercise in USAFE as a tool for hazard analysis, response training and hazard management for USAF bases. CHAS performs the following functions:

1. Allows the user to examine various chemical attack scenarios, to construct strategies for defense detector layout, and to plan postattack air base reconstitution.

2. Provides the user with postattack status of air base personnel and material.

3. Provides the user information on the various aspects of chemical hazards, including area coverage (dosage and concentration), detector system performance persistence of the agent, and toxic effects (casualties). Casualty effects are computed for personnel defined in different levels of personal protection and either inside buildings or in the open. Computation of agent dosage inside buildings is based on filter factors and air exchange rates defined by the user for each building.

DESCRIPTION:

Domain: Land

Span: Local.

Environment: Facilities with data base information, population centers, weather conditions.

Force Composition: N/A.

Scope of Conflict: Primarily chemical weapons effects, but some conventional weapons effects can be evaluated.

Mission Area: Air base operations and vulnerability.

Level of Detail of Processes and Entities: Chemical munitions can be delivered by missile, bombs, or artillery either mixed or in multiple attacks at specified time periods. Conventional attacks are currently limited to aircraft delivered bombs. Personnel and detectors can be individually placed in the target area. Casualties are reported for all population centers and detector status reports can be obtained.

CONSTRUCTION:

Human Participation: Required, the system waits for decisions.

Time Processing: Dynamic with time-step.

Treatment of Randomness: Weapon delivery errors.

Sidedness: One-sided.

LIMITATIONS: Produces discrete "snap-shots" of chemical challenge; personnel are stationary throughout the scenario; weather conditions are assumed constant for the duration of the chemical threat.

INPUT: Scenario development: attack profile, target profile, weather profile, detector profile (optional), population profile (optional), chemical

munitions effects data base, model parameters (e.g., agent data: physical constants, agent toxicity, equipment protection factors, detector thresholds).

OUTPUT: Graphic display of chemical contamination, hardcopy plots of target area, casualty reports and casualty streams, detector status reports, building damage.

HARDWARE AND SOFTWARE:

Computer(OS): UNIX, XENIX, AIX.
Storage: 4MB memory, 40MB hard disk.
Peripherals: VGA monitor, mouse, printer (optional) and plotter (optional).
Language: FORTRAN 77, GKS.
Documentation: User Manual, Programmer Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: A basic target can be digitized from a facilities map in 10 man-hours plus technical support. Inclusion of target element data will increase man-hours depending on level of detail to be digitized. The chemical munition effects data base is generated off-line at 5-20 minutes per case.

CPU time per Cycle: Fast response time.

Data Output Analysis: On screen displays, plus hardcopy reports and plots.

Frequency of Use: Weekly.

Users: JAYCOR, AL/CFHD and HSD/YA (USAF), DRES (Canada), NRDEC (U.S. Army), Saudi Arabia.

Comments: Model developed by JAYCOR, Dayton, Ohio, under USAF contract to AL/CFHD, WPAFB, OH.

TITLE: CHEMCAS III - Chemical Casualty III.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: United States Army Chemical School (USACMLS), ATTN: ATZN-CM-CC, Ft. McClellan, AL 36205-5020.

POINT OF CONTACT: Mr. Tom Collins/CPT Michael O. Kierzewski, (205) 848-3174/3659, AV 865-3174/3659.

PURPOSE: CHEMCAS III is used to analyze weapons systems effectiveness against targets. It determines casualties and provides quantitative estimates of agent deposition and dosage levels on target. CHEMCAS III is used primarily to compare various weapons systems and to be a casualty levels feeder model for larger force on-force models. The dosage and deposition effects are actually calculated by the NUSSE III model used as a module for CHEMCAS III.

DESCRIPTION:
Domain: Land.

Span: Accommodates any theater with adequate weather and terrain data base. Meteorological data comes from the EOSAEL CLIMAT Data Base.

Environment: N/A.

Force Composition: Currently Army maneuver units only.

Scope of Conflict: Chemical weapons effects only. No nuclear weapons or the high explosive effects from chemical munitions are modeled.

Mission Area: All missions and weapons combinations that can be used to deliver chemical munitions.

Level of Detail of Processes and Entities: For artillery-delivered munitions, CHEMCAS III uses volleys from four or six tube artillery batteries. Target units can be handled down to company level but the normal target unit is the battalion. Target units are stationary, and firing units are limited in the number of rounds available to them (based on unit basic loads and resupply rates).

CONSTRUCTION:
Human Participation: Required to provide the interface between modules and to perform the fireplanning for the model.

Time Processing: Dynamic in that model treats dosage at different times from the first round impacts on the target.

Treatment of Randomness: Stochastic process used to model aim point and dispersion errors as independent bivariate normal random variables.

Sidedness: One-sided.

LIMITATIONS: Model does not currently consider bombs or missiles for dissemination of chemical agents. In addition, the applicability of CHEMCAS III is limited by the data base limitations of NUSSE III. For example, NUSSE III parameters are derived for limited types of soil and vegetation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of chemical agent bombs and missiles; a version of CHEMCAS III that will run on a personal computer (Zenith) is under development.

INPUT: Target size and protection level, current weather data (temperature stability, windspeed), terrain data (vegetation, soil and surface type) chemical agent used, and the munition used for delivery.

OUTPUT: Percentage of the target that is exposed to different dosages or deposition rates at a specified time after impact of the first round and the percentage of personnel in the target area who will become casualties (threshold, incapacitation, or lethality).

HARDWARE AND SOFTWARE:

Computer:	Currently designed to run on the UNISYS 1100/70 resident at Aberdeen Proving Ground-Edgewood Area.
Storage:	Approximately 1.5 MB with 1 MB dedicated to NUSSE III.
Peripherals:	Minimum requirements: a VT100 terminal and a printer.
Language:	UNISYS FORTRAN.
Documentation:	Under revision. Current documentation from Science application International Corporation dated February 1988.

SECURITY CLASSIFICATION: Unclassified, but weapons effects data bases are classified.

GENERAL DATA:

Data Base: One hour required to prepare the inputs for one run.

CPU time per Cycle: Total run time including NUSSE III is 10 minutes. If NUSSE III were run previously, the run time for CHEMCAS III would be 3-5 minutes.

Data Output: Analysis: No real analysis performed.

Frequency of Use: Used weekly by USACMLS.

Users: USACMLS and CRDEC.

Comments: Configuration control exercised by USACMLS.

TITLE: CISCIAD - Combat Identification System COMO Integrated Air Defense.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: TRADOC Analysis Command - White Sands Missile Range (TRAC-WSMR), White Sands Missile Range, NM 88002-5502.

POINT OF CONTACT: Mr. Daniel Bretl, (505) 678-4287, AV 258-4287.

PURPOSE: CISCIAD is a research and evaluation tool used to conduct high resolution air defense studies, including combat identification.

DESCRIPTION:
Domain: Land and air.

Span: Regional.

Environment: Uses digitized terrain, 100 meter squares with vegetation. Time of day and weather reflected in input data for weapon systems.

Force Composition: BLUE air defense and aircraft versus RED aircraft.

Scope of Conflict Conventional.

Mission Area: Air defense.

Level of Detail of Processes and Entities: Individual fire units and aircraft are simulated, up to a corps level of air defense. Command and control (fire levels), ECM jamming, and combat identification systems are also modeled.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, critical event-step model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, RED is nonreactive.

LIMITATIONS: The maximum number of fire units and aircraft that can be played are 300 and 1024, respectively. Nuclear and chemical warfare and logistics are not modeled. There is no ground-to-ground combat.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Scenario, weapon characteristics, aircraft flight paths, ECM jamming data, combat identification system data, and command and control element characteristics.

OUTPUT: Computer printout of RED and BLUE kills, time of kills, engagement ranges, etc. Graphics playback of movement, engagements, and kills.

HARDWARE AND SOFTWARE:
Computer(OS): VAX/VMS operating system.
Storage: 150K.
Peripherals: Printer and graphics.
Language: FORTRAN 77.
Documentation: Veda, 103065-87U/P1035, User's Manual, 6 May 87.

SECURITY CLASSIFICATION: Unclassified, but data bases are usually classified.

GENERAL DATA:

Data Base: Six months.

CPU time per Cycle: One to six hours on VAX 8600.

Data Output Analysis: Postprocessor.

Frequency of Use: Several times per year.

Users: MICOM, CAA, and TRAC-WSMR.

Comments: CISCIAD is the version of COMO used by and maintained by TRAC. It was developed from the CIAD model which originated at the SHAPE Technical Centre.

TITLE: CLDGEN - Cloud Scene Generator Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: United States Air Force Environmental Technical Applications Center (USAFETAC), Environmental Simulation Section. USAFETAC/DNY, Scott AFB IL 62225-5438.

POINT OF CONTACT: Capt Anthony J. Warren, DSN 576-5412, Commercial (618) 235-5412.

PURPOSE: CLDGEN is a weather simulator. Specifically, CLDGEN generates the spatial distribution of clouds, at fixed locations, as a function of time. The model was developed for computing surface-based cloud-free line-of-sight probabilities between the surface and an orbiting satellite. The model has been used to assess the impact of clouds on a ground-based laser system, and for a study determining the optimal placement of a ground-based satellite detection system.

DESCRIPTION:
Domain: The model generates cloud scenes as observed from the surface.

Span: Global. The model generates scenes at a specified point. Several points can be studied simultaneously, as the model preserves observed spatial and temporal correlation properties.

Environment: Serves as an environment sub-model to large-scale simulation models.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: The model provides binary cloud data (cloud/no cloud) at any point in the sky as a function of time. It does not simulate individual cloud layers or provide any information on cloud height. Any number of points can be simultaneously modeled. The output also contains the total fraction of the sky covered by clouds.

CONSTRUCTION:
Human Participation: Not required, but is permitted.

Time Processing: Dynamic, time-stepped model. A fixed time-step is not required.

Treatment of Randomness: Stochastic. Monte Carlo simulation is used. The four-dimensional Boehm Sawtooth Wave model is used to generate fields of random numbers with specified spatial and temporal correlation structures.

Sidedness: One-sided.

LIMITATIONS: Model assumes cloud distributions are isotropic. Does not apply to mountainous areas or coastal areas where anisotropic distributions occur.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Parameters of the Burger Aerial Algorithm, used to model the cloud-cover distributions. There are two parameters (mean cloud-cover and scale distance) for each hour of the day, by month. A set of these coefficients is needed for each site. During the simulation, the model requires the time and location in the sky (zenith and azimuth angles) of the target under consideration.

OUTPUT: Raw data.

HARDWARE AND SOFTWARE:

Computer(OS): Designed on an IBM mainframe running the MVS operating system, but written in ANSI-standard FORTRAN specifically to enhance portability to other computers and operating systems.

Storage: 252 kilobytes.

Peripherals: None required.

Language: ANSI standard FORTRAN 77.

Documentation: USAFETAC/TN-90/003, CLDGEN Users Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Model coefficients are prepared by USAFETAC/DNY. Time requirement for preparation is minimal.

CPU time per Cycle: Dependent upon the number of locations and the desired time-step. A 10-year simulation tracking a satellite in a 19,000 km orbit required about 15 min of CPU time.

Data Output Analysis: N/A.

Frequency of Use: Model has been used several times per year since its inception.

Users: USAFETAC, Phillips Laboratory, Air Force Center for Studies and Analysis.

Comments: USAFETAC recently completed a validation study of this model. The results will be published later this year in an USAFETAC technical report.

TITLE: CLEAR - Campaign Logistics Expenditure And Replenishment Model.

DATE IMPLEMENTED: March 1991.

MODEL TYPE: Analysis.

PROPONENT: Commander-in-Chief Pacific Fleet (CINCPACFLT Code 03).

POINT OF CONTACT: Mr. C. DeLeot, (808) 471-8635.

PURPOSE: Research and Evaluation Tool used for force capability and requirement studies dealing with resource planning. CLEAR is integrated with the CINCPACFLT air strike model (THOR) and battle group defense model (ASBAT). CLEAR models the supply availability for a deployed, multi-carrier, battle group. Non-combat consumption and replenishment are modeled. Combat consumption is modeled and determined by the warfare models executed in conjunction with CLEAR.

DESCRIPTION:

Domain: Naval unit and port supply consumption and throughput.

Span: Considers movement of supplies from CONUS to deployed fleet naval units.

Environment: Supply throughput function of sea-state. Weather does not affect ports.

Force Composition: Ships and port facilities.

Scope of Conflict: No conflict represented. Warfare damage modeled in linked models.

Mission Area: Logistics, non-combat consumption and supply replenishment.

Level of Detail of Processes and Entities: Ships and ports represented by the supplies being carried, supply consumption rate, and reorder level data. Supply ship and port entities model number and type of supply transfer facilities, and number of simultaneous transfer operations allowed. Thirty-two characteristics can be established to limit supply category throughput at a facility. Ships and ports have a logistics chain of command independent of their command structure. Events include ship arriving at port to load supplies, ship arriving at port or battle group to unload supplies, ship joining or leaving a logistics chain of command.

CONSTRUCTION:

Human Participation: All human decision about logistics events are input as part of the execution data base. Model executes without human intervention.

Time Processing: Dynamic event-step model with some time-step overlays.

Treatment of Randomness: Deterministic model. Linked Monte Carlo combat models cause random combat consumption and the results from replication to replication are different.

Sidedness: One-sided.

LIMITATIONS: The model does not attempt to alter the pre-planned leaving and arriving port event schedule based on other events that may occur. All transfer facilities are 100% reliable. An unlimited number of supply categories can be represented, but each supply category must be labeled as wet, dry or ammunition for throughput classification.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Development continuing, limitations are being addressed.

INPUT: Supply categories, facilities that transfer supplies, number and description of simultaneous replenishment resources on supply ships and at ports, the ships and ports being considered and their logistics organization, consumption parameters for all units by supply category, supply reordering information, and on hand supplies at the start of the analysis run.

OUTPUT: Current on hand supply level for deployed ships is output just prior to executing the combat events modeled by THOR and ASBAT. End of analysis summary of the amount of supplies consumed, transferred, received, and remaining for each unit modeled.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX under VMS. Runs on SUN using UNIX.
Storage:	Requires approximately 2000 blocks of storage for its source code.
Peripherals:	One CRT.
Language:	FORTRAN 77.
Documentation:	Analyst Guide, contains explanation of algorithms with numeric examples, global COMMON block variable definitions, and data organization.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Two man-months for a fleet wide data base.

CPU time per Cycle: One minute execution time for each day of simulated time.

Data Output Analysis: 10th and 90th percentile information calculated by the model.

Frequency of Use: Daily.

Users: CINCPACFLT. Fiscal 92 distribution scheduled as part of CASES.

Comments: Model developed solely to support supply side of the logistics problem for CINCPACFLT combat models. Model development concentrated on integration to other models. Improvements will concentrate on more robust underway replenishment process.

TITLE: CLIPF - Complex Linear Predictor Filter.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: For analysis of CLIPF application to RF cancellation of high duty interference.

INPUT: Initial predictor parameters. Parameters of simulated signal environment.

OUTPUT: Plots of filter characteristics. Plots of input signal composite. Plots of canceled output vs. time.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780-782; requires array processor.
- Storage: 50K Bytes of 8 Bits; memory requirements: 1M Bytes of 8 bits.
- Language: FORTRAN IV Plus.
- Documentation: Technical Memoranda; Test/Verification/Validation Reports.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
- Data Base: Preparation time is 1 hour.
- CPU time per Cycle: 10 minutes on VAX computer.
- Comments: Status of Model - completed; debugged. Full verification and validation done.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: CMARPS - Conventional Mating and Ranging Planning System.

DATE IMPLEMENTED: Original delivery 1983. Enhanced versions are delivered annually.

MODEL TYPE: Analysis. Used to support actual operations and exercises.

PROPONENT: HQ/SAC DOOM.

POINT OF CONTACT: Rick Clough, Logicon Inc., 222 W. 6th St., San Pedro, CA 90733, (213) 831-0611.

PURPOSE: CMARPS is used as an operational support tool and a research and evaluation tool for air refueling operations. It provides tanker force capabilities and requirements information in support of single-cell to full-force refueling operations.

DESCRIPTION:

Domain: Air and land (i.e., base capacities are modeled).

Span: Models can be used globally.

Environment: N/A.

Force Composition: Any aircraft can be modeled, provided performance polynomials or tables are available. Currently, the combined aircraft assets of Air Force, Marines, Navy, and Army can be modeled.

Scope of Conflict: Refueling support for all conventional operations (employment and deployment). Non-SIOP Option operations can also be supported.

Mission Area: All conventional air operations including airlift, reconnaissance, deployment, and employment.

Level of Detail of Processes and Entities: The lowest level entity of simulation is the performance of a single aircraft (tanker and/or receiver). Other entities modeled are cells of aircraft and units of aircraft (several cells grouped together). Processes modeled include:

- climbs and descents.
- fuel transfers.
- aircraft turns including varying bank angles.
- aircraft configuration changes due to cargo, fuel, and/or weapon drops.
- aircraft avoidance of user defined regions.
- aircraft attrition avoidance for single cell and single aircraft.
- aircraft deconfliction in strike areas.
- tanker assignment and scheduling against receiver force refueling and movement requirements.
- climatological effects (i.e., winds).
- anchor refueling operations ("gas station in the sky").
- KC10 as a dual-role tanker (i.e., cargo carrier and tanker).
- air refuelable tankers (ARTs) employed when necessary.

CONSTRUCTION:

Human Participation: Required for data base modification and scenario setup.

Time Processing: Dynamic, event-stepped model. Progresses through events as they occur during simulation of scenario.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: Two-sided, reactive model. Receiver's fuel requirements must be satisfied in accordance with tanker fuel capabilities.

LIMITATIONS: Only five tanker types currently modeled (KC10, KC135R, KC135E, KC135A, and KC135Q). Length of an operational plan limited to 120 days.

PLANNED IMPROVEMENTS AND MODIFICATIONS: User interface is being converted into X-Windows based format. Additional capabilities are included annually at direction of HQ/SAC. Future planned improvements include refueling operations employing wing pods on tankers, additions to employment modeling, usage of forecast wind information, optimal routing considering winds, optimal reconnaissance routing, conversion of software to Ada language, etc.

INPUT: Inputs include aircraft sortie information, tanker basing, aircraft characteristics, weapons characteristics (weights and degrades), avoidance regions, receiver unit composition (e.g., 6 cells of F16s with 6 aircraft in each cell), scenario constraints, etc.

OUTPUT: Large amount of information displayed on operational maps. Produces textual reports of all refueling operations (e.g., refueling times and locations, tanker usage, total fuel requirements, etc.).

HARDWARE AND SOFTWARE:

Computer:	Designed to run on SUN SPARCstation environment. Analytical modules have run on IBM mainframe environment and PC OS/2 environment.
Storage:	Minimum 16 MB of RAM required. Minimum 600 MB of disk space required for data bases, executable modules, and sufficient space for scenario generation and usage.
Peripherals:	Printer for textual reports. Color printer useful for graphical printouts, but black and white is sufficient.
Language:	FORTRAN 77 for analytical modules. Graphical display modules programmed in C language using X-Windows and SUN GKS for display generation.
Documentation:	User's manuals and checklists available.

SECURITY CLASSIFICATION: Unclassified, but data bases may contain classified material.

GENERAL DATA:

Data Base: Large data bases are already populated and maintained. Single scenario generation may require as little as 10 minutes for small scenarios and up to several days for full force deployment/employment scenarios.

CPU time per Cycle: Varies by scenario size. Processing of most scenarios requires less than 1 hour of CPU time.

Data Output Analysis: Hardcopies of data can be generated. Graphical display of most output is also available.

Frequency of Use: Used at least weekly for operational support and/or analysis.

Users: HQ/SAC DOO, HQ/SAC DOR, AFCSA, RAND Corporation, 15th Air Force, Military Airlift Command, 99th SWW.

Comments: CMARPS was deployed on a SUN SPARCstation to the Persian Gulf in support of operations Desert Shield and Desert Storm.

TITLE: CMUES - Campaign Model Utilizing Environmental Sim.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: For RF receiver design.

DESCRIPTION: All red/blue acft paths are generated simply from a set of 6 lat/long waypoints. Ground threat geometry is usually derived from MSFD data. The model calculates and utilizes emitter geometry (ground and airborne), acft flight profiles, emitter mode profiles and receiver parameters to determine the RF environment at desired points in time. The program also calculates RF pulse statistics (Density, Prob of Overlap, etc.).

INPUT: Ground red and blue laydown; airborne red/blue platform flightpaths; emitter parameter list, emitter mode characteristics; campaign parameter file (model parameters), receiver parameters, freq/angle bins, sensitivity.

OUTPUT: Print/plots of ground emitter positions and platform flight paths. Printout of emitters received vs. angle, frequency, type, for given times. Also creates files of emitter geom/data for use in other models (BATS).

HARDWARE AND SOFTWARE:

- Computer: DEC VAX-780; PVAX display (220) recommended.
- Storage: 50K Bytes; memory requirements: 4M Bytes.
- Language: FORTRAN/77 (VAX).
- Documentation: Technical Memoranda and Test/Verification/Validation Reports.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is secret (if MSFD).

GENERAL DATA:

Data Base: Typical data: 2 days.

CPU time per Cycle: 10 minutes on VAX computer.

Usage: Used for RF receiver design and to provide environment for bistatic receiver models (BATS).

Comments: This model incorporates preprocessor programs for data preparation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: COED - Communications Environment Description.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Calspan Corp./Wright Laboratory.

POINT OF CONTACT: Gregory M. Lewandowski.

PURPOSE: The COED model is a research and development tool used to aid in the analysis of signal environments in the frequency band usually supporting communications signals (20-3000 MHz). The model is designed to simulate RF communication signals as received by a probe (player or listener) flying in a scenario, using equipment characteristics and locations, and command and control structures and doctrine. Tactical and strategic problems have been addressed.

DESCRIPTION:
Domain: Land, air, sea, military, civilian.

Span: Accommodates any theater depending on the data base. At present, the area used is Europe from 8-60° east longitude and 45°-72° north latitude.

Environment: Near-earth propagation loss using the Longley-Rice methodology is computed in the model.

Force Composition: Joint and combined forces - Blue, Red, Gray, and civilian.

Scope of Conflict: Communication signal can be generated for tactical or strategic conflict emitters, and includes civilian emitters.

Mission Area: Signal simulation is dependent on data base input regardless of mission type.

Level of Detail of Processes and Entities: Individual emitter signals are simulated in time. The receiver (with detailed receiver antenna pattern) flies a predefined flight path through a scenario area. The receiver senses the total signal environment with emitters viewed, not as separate entities but rather as members of networks. The model allows one emitter in a network to transmit at a time. Emitter characteristics and locations are used with activity information and a network list that defines associations among emitters to turn emitters on and off during the duration of the receiver probe flight path. Communications emitters onboard dynamically controlled (GCI/ACI) AI are also included. Primary, secondary, tertiary and other equipments are modeled. Emitters may simulcast on up to six channels using any mix of a wide variety of emitter types. Seven generic antenna patterns are available and may be swept in azimuth and elevation. Antennas may also be pointed at the receiving aircraft. Dynamic AI intercepts can be initiated when the receiver probe enters LOS with both GCI and ACI locations. CAP aircraft are vectored on a collision course to the receiver aircraft. Also, increased signal transmissions are simulated.

CONSTRUCTION:
Human Participation: Input data preparation and output analysis. The COED model processes 3000 networks/emitters at a time and can be interrupted after these intermediate runs.

Time Processing: COED is a dynamic, event-stepped model.

Treatment of Randomness: Emission activity and duration are treated statistically, constrained by intelligence information. Emitter frequency can be selected in one of four ways, three of which depend on a random selection. Starting boresight azimuth and elevation, except for trackers, are selected randomly.

Sidedness: The COED model simulates friendly, unfriendly and other communications emitters.

LIMITATIONS: The COED model does not support frequency hopping at this time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of frequency hopping algorithms.

INPUT: Equipment characteristics, emission activity and duration statistics, emitter locations, near-earth attenuation attributes, flight path information, network data, antenna control data, interceptor information, and output configuration controls.

OUTPUT: Graphic output of received signal time history of background and specific target signals constrained by user input. Printouts of signals received and their characteristics. Plots and printouts showing statistics by band and modulation of the number of signal deaths, net signals, and number of signals alive in 50 millisecond windows over time. Frequency of occurrence of signal births, deaths, net and alive by band and modulation.

HARDWARE AND SOFTWARE:

Computer:	IBM 370 series.
Storage:	Magnetic tape.
Language:	FORTRAN 77, SAS.
Documentation:	Internal comments, draft user's manual.

SECURITY CLASSIFICATION: Unclassified, but input data are often classified.

GENERAL DATA:

Data Base: Depends on the extent of the input data with two to three months being reasonable for input preparation.

Data Output Analysis: Because of the extensive data analysis capabilities, analysis of final results can be accomplished within days or weeks depending on extent required.

Frequency of Use: At least one run per day during an experiment after data preparation. 30 to 50 runs are not uncommon.

Users: ASD, ESD.

TITLE: COGNIT - Cognitive Minesweep Planner.

DATE IMPLEMENTED: April 25, 1987.

MODEL TYPE: Analysis.

PROPONENT: Mine Warfare Command, NAVSTA BLDG NS-1, Charleston, SC 29408-5500.

POINT OF CONTACT: Mr. Joseph Mattingly, Code N4C (803) 743-5405, AV 563-5405.

PURPOSE: COGNIT is an operational support tool used to optimize naval minesweeping tactics. It assists the user in identifying tactics that provide favorable combinations of attrition and effort. The model considers three measures of effectiveness (MOEs): minefield clearance level, expected minesweeper casualties and direct effort (in time required to complete all runs on all tracks). During each model cycle, the user solves one of three planning problems, in which tactics are selected to optimize one MOE subject to user-defined constraints on the other two.

DESCRIPTION:

Domain: Sea and undersea.

Span: Local.

Environment: All environment is implicitly specified through values users assign during model problem specification.

Force Composition: Naval mines and minesweepers only. Mines are assumed to be of a single type and setting, with the exception of ship count setting. All minesweepers have identical minesweeping characteristics .

Scope of Conflict: Conventional.

Mission Area: Sea control.

Level of Detail of Processes and Entities: Individual minesweepers and mines are not explicitly represented. Minesweepers are continuous rather than discrete entities. Mines are represented by a uniform distribution of mine locations through which minesweepers must pass. Attrition is bilateral: minesweepers clear mines and mines cause minesweeper casualties. Both types of attrition are functions of minesweeper tactics, which also determine the amount of effort expended in sweeping a minefield.

CONSTRUCTION:

Human Participation: Required. COGNIT requires interactive input of: minefield characteristics, minesweeper characteristics, two of three MOEs in order to specify the problem to be solved.

Time Processing: Dynamic, closed form. However, results are not presented as time dependent.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Limitations include consideration of single minesweeper and mine types and a limited variety of ship count distribution for mines. Model is also limited to considering sweeping tactics characterized by fixed track spacing and number of runs per track. Other limitations are discussed in the documentation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Make headings more descriptive for both screen and hardcopy output.

INPUT: Data describing minefield characteristics, minesweeper characteristics, minesweeper-mine interactions (actuation and damage data), and problem specification (including values of constrained MOEs).

OUTPUT: Screen displays and optional printed output giving input values (as above) and problem solution.

HARDWARE AND SOFTWARE:

Computer (OS):	IBM-Compatible PC (MS-DOS).
Storage:	150K bytes.
Peripherals:	Interactive keyboard and monitor, optional printer.
Language:	ANSI Standard FORTRAN 77 with restricted code to conform with COMINEWARCOM FORTRAN Programming Standards.
Documentation:	USCINCPAC Technical Report, A Cognitive Planning Aid for Naval Minesweeping Operations, 25 April 1987. (Revised April 1988.) The software includes on-line help utilities, a tutorial, sample problems, and user notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minutes.

CPU time per Cycle: Minutes. Hours for more complex problems.

Data Output Analysis: Minutes.

Frequency of Use: As required during each MCM exercise.

Users: MCM Commander's staff.

Comments: None.

TITLE: COM/EW - Tactical Communications/Electronic Warfare.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: COM/EW is a research and evaluation tool used to analyze system effectiveness (with application to force capability and requirements effectiveness). It provides the user with an interactive automated capability to evaluate the performance of COM systems, electronic IR systems, and electronic ELS in a hostile electromagnetic environment. It is suited to analyze hypothetical tactical and training environments, and is applicable to the analysis of interactions between the following: point-to-point communication using conventional, direct sequence spread spectrum, or frequency hopping spread spectrum techniques; jamming using conventional, direct sequence spread spectrum or repeater techniques; emitter location systems using time-of-arrival, interferometer, rotating beam, or multibeam techniques; and intercept receivers using conventional techniques.

DESCRIPTION:

Domain: Land with limited air and naval operations.

Span: Regional simulation and analysis.

Environment: Terrain effects considered, given Defense Mapping Agency (DMA) Level I Digital Terrain Elevation Data (DTED) for the region of interest. Ground constants and atmospheric parameters also considered. One of three levels of ambient noise can be selected. Ionospheric parameters, date, and sunspot number used in VAX implementation.

Force Composition: RED and BLUE; independent of administrative organizational affiliation.

Scope of Conflict: Primarily conventional warfare. Nonelectromagnetic combat effects and nuclear detonation effects not considered.

Mission Area: Communication, SIGINT, and communication jamming missions.

Level of Detail of Processes and Entities: COM/IR/ELS station, link, and net performance evaluated based on specified geographic deployment (snapshot) and detailed C-E system characteristics. Effects of station motion not considered. COM performance analyzed considering RED and BLUE force jamming with limited consideration of BLUE force communications contention. Results include prediction of AS, BER, and status. IR performance analyzed similarly to COM without consideration of BLUE force communications. ELS performance analyzed considering noise effects only. Results include prediction of the accuracy of DOA and TOA measurements on targeted emitters and associated confidence in those measurements based on CEP.

CONSTRUCTION:

Human Participation: Required to define forces (deployment, C-E system characteristics) and select analysis processes.

Time Processing: Static.

Treatment of Randomness: Deterministic (expected value) and stochastic (Monte Carlo).

Sidedness: One-sided.

LIMITATIONS: Up to 50 interfering/target nets with less than 50 stations each and 100 frequencies (between 1 MHz and 20 GHz) can be considered in analysis. Nonlinear electromagnetic effects and operational duty factors not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Interface with equipment characteristics data base and small-scale operational enhancements.

INPUT: Data Base Module requires net (deployment, C-E system characteristics) data. Analysis Module accesses net data files and topographic data files, and requires analysis directives.

OUTPUT: Displays and printouts of data and results. VAX version also produces graphic plots. Postprocessor allows merging of results.

HARDWARE AND SOFTWARE:

Computer:	A version runs on the UNISYS 1100/Sharing Exec - multiprocessor system level 39R8-OP-104. A version runs on the VAX computer under the VMS operating system.
Storage:	VAX program: 2.7 MB UNISYS program: .5 Megawords. Additional storage requirements depend on deployment size and topographic data base.
Peripherals:	One printer, one graphics suite (VAX only-optional), and one terminal.
Language:	FORTRAN.
Documentation:	Each version separately documented.

SECURITY CLASSIFICATION: Unclassified program, but data and results may be classified.

GENERAL DATA:

Data Base: Population of large data base can take several man-days.

CPU time per Cycle: Depends on data base size. Generally, requires several minutes of CPU time.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Varies by command.

Users: DoD, ECAC, JEWC, and U.S. Army CM/CCM Center.

Comments: Originally developed by ECAC for U.S. Army CM/CCM Center.

TITLE: Combat Model ELAN+.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: TRADOC Analysis Command - White Sands Missile Range (TRAC-WSMR), White Sands Missile Range, NM 88002-5502.

POINT OF CONTACT: Dr. H.M. Sassenfeld, (505) 678-1615, AV 258-1515.

PURPOSE: ELAN+ is a two-sided, event-sequenced, deterministic/stochastic combat model for up to brigade-level combat. Activities modeled are maneuver, acquisition, direct fire, fire support, mines, smoke, terrain, and weather. All actions can be triggered by combat situation and specifiable doctrine.

DESCRIPTION:
Domain: Land (air).

Span: Platoon to brigade.

Environment: Terrain.

Force Composition: Combined forces.

Scope of Conflict: Conventional.

Mission Area: Land combat.

Level of Detail of Processes and Entities: Single weapon system geometric and time resolution specifiable.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Dynamic.

Treatment of Randomness: Either deterministic or stochastic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: None, except total run time depending on specified resolution.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Handling of combat support.

INPUT: Routes of forces, maneuver and fire support schedules, and weapon performance data from keyboard.

OUTPUT: Weapon effectiveness measures and force losses.

HARDWARE AND SOFTWARE:
Computer(OS): Microcomputer, UNIX.
Storage: 8 MB RAM, 50 MB hard disk.
Peripherals: Printer or plotter.
Language: Hewlett Packard Basic (Pascal), FORTRAN.
Documentation: Annotated source code, user manual.

SECURITY CLASSIFICATION: Unclassified, classified with weapon-performance data.

GENERAL DATA:
Data Base: Several days.

CPU time per Cycle: N/A.

Data Output Analysis: Via concurrent numerical and graphic representation.

Frequency of Use: Continuous.

Users: TRAC-WSMR, TRAC-FLVN.

Comments: None.

TITLE: COMBAT IV.

DATE IMPLEMENTED: July 1984.

MODEL TYPE: Analysis.

PROPONENT: Defense Nuclear Agency, NATO, SHAPE, CAA, SAC, and The BDM Corporation, CAA, SAC.

POINT OF CONTACT: Mr. Jack Haas or Mr. Michael McMillie, BDM Corporation, McLean, VA 703-848-6384.

PURPOSE: COMBAT IV is a research and evaluation tool used to assess weapon system effectiveness; force capability and requirements; courses of action; force mix options; force effectiveness and resource planning; and combat development for current or new doctrine, competing strategies, and policy study in the areas of theater warfare.

DESCRIPTION:
Domain: Air and land, and limited naval (at the theater level).

Span: Theater or regional.

Environment: Terrain features represented in abstract terms at corps-level or division sector-level in depth. Weather and time of day effects also modeled.

Force Composition: Air and land forces; limited naval.

Scope of Conflict: Conventional, chemical, and nuclear.

Mission Area: All aspects of theater and regional campaign analysis.

Level of Detail of Processes and Entities: Explicit SAM fire units by type, ground forces by brigade equivalent, explicit SAM fire units by and surface to surface missile launchers by type, and explicit air bases.

CONSTRUCTION:
Human Participation: Not required. Model interruptable with scheduled changes.

Time Processing: Dynamic with one-hour time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Ground force representation aggregated at brigade level.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Added fidelity in ground force representation.

INPUT: Terrain geometry, characteristics, weapon system capabilities, force size, deployments and allocations, munition stockpiles, decision rules for force employment, scenario, scheduled force employment and allocation changes, and scheduled reinforcements.

OUTPUT: Printouts over time and full, postprocessed graphic output for trends over time and map graphics.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS family.
Storage:	10 MB.
Peripherals:	Printer and hardcopy graphics.
Language:	VAX Pascal. Postprocessors in FORTRAN 77 with DISSPLA graphics interface.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Three to six man-months (various Central Region scenario data bases are available).

CPU time per Cycle: Eight minutes per day of combat.

Data Output Analysis: Postprocessor provides graphics as well as raw data output.

Frequency of Use: Constant.

Users: NATO HQ Brussels, Belgium; SHAPE Technical Center; U.S. Army Concept Analysis Agency; LTV Corporation; the BDM Corporation.

Comments: Requires operational effectiveness data as input, typically obtained from more detailed models.

TITLE: COMET - Calculation of Missile Entry Time.

DATE IMPLEMENTED: 1984.

PROPONENT: HQ AFSPACECOM/CNF.

POINT OF CONTACT: Mr. Jesse Conti, 554-5465/Mr. Steve James, 554-3589.

PURPOSE: COMET simulation is a software utility developed to provide time of missile entry into radar coverage and related data for ground based missile warning radars which may be capable of observing some portion of a missile's trajectory.

DESCRIPTION:

Domain: Land and Space.

Span: Global.

Environment: Models ICBM and SLBM trajectories. The radar coverages modeled are PAVE PAWS, BMEWS, COBRA DANE, PIRINCLIK, and PARCS.

Force Composition: Red ICBMs and SLBMs; Blue Ground Based Missile Warning Radars.

Scope of Conflict: ICBMS and SLBMs against CONUS, Pacific targets, Europe and Middle East.

Mission Area: Radar Coverage and Warning Times.

Level of Detail of Processes and Entities: The threat can be up to 1000 ICBMs/SLBMs combined. COMET computes the trajectory burn phase by doing a fourth order polynomial fit to the missile characteristics data base, then COMET uses standard flight dynamics theory to fly the missile. Missile visibility by the sensor is determined by comparing current missile position with the geometric extents of the radar's coverage.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic, time-stepped model.

Treatment of Randomness: Direct Computation.

Sidedness: One-sided.

LIMITATIONS: No error checking; missile characteristics data base can only be modified by changing a FORTRAN program and then recompiling.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None; Improvements are made on an as needed basis.

INPUT: Launch and Impact Points (latitude, longitude, and height). Sensor(s) of interest including boresight azimuth and elevation. maximum and minimum search azimuth, elevation, and range. Missile type and type of trajectory: 1) Use the missile characteristics data base to determine the flight path angle at burnout; 2) Input the flight path angle; 3) Calculate flight path angle that will use minimum amount of energy to fly the missile.

OUTPUT: Produces on-screen or printed data: 1) Missile is/is not capable of flying distance; 2) Apogee; 3) Flight time/time to impact; 4) Flight range;

5) Flight path angle at burnout; 6) Orbital parameters; 7) Missile did/did not enter radar coverage; 8) Sensor time, azimuth, elevation, and range for missile entry/exit into radar coverage and report transmission.

HARDWARE AND SOFTWARE:
- Computer: VAX and PC.
- Storage: 1000 blocks.
- Peripherals: 1 Terminal, 1 Printer.
- Language: FORTRAN.
- Documentation: Documented in 1 manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Missile Data Base: 1 to 3 months; Sensor Data Base: 1 to 3 hours.

CPU time per Cycle: 5-8 seconds per trajectory.

Data Output Analysis: Depends on specific requirements.

Frequency of Use: Varies by Command Taskings.

Users: HQ AFSPACECOM.

Comments: None.

TITLE: COMMANDER V - Tactical Air/Land/Naval Operations Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC), 400 Franklin Road, Suite 200, Marietta, GA 30067.

POINT OF CONTACT: Mr. Jeffrey D. Wise, (404) 426-7774.

PURPOSE: COMMANDER V is a balanced air/land/naval battle simulation that is primarily used to evaluate weapons system effectiveness and sensitivities, weapon system employment concepts, force mix effectiveness, and force employment strategies.

DESCRIPTION:

Domain: Air, land, and naval operations.

Span: Typically multiple BLUE, corps engaging multiple RED armies. Central European and Southwest Asia data bases have been completed.

Environment: Terrain is gridded with direction-dependent movement degradation and capacities input for both wheeled and tracked vehicles. Natural and man-made obstructions are explicitly modeled including rivers and minefields. Models day and night operations and localized and transient weather effects.

Force Composition: BLUE, RED, joint, and combined forces.

Scope of Conflict: Primarily conventional warfare.

Mission Area: Ground operations include armor, infantry, artillery, army aviation, combat support and combat service support. Air operations include CAS, BAI, AI, OCA, DCA, airlift, AGACS, and reconnaissance. Naval operations include surface, air, aircraft carrier, amphibious and sealift.

Level of Detail of Processes and Entities: Ground units can be modeled to the squad level but more typically are aggregated at the battalion or brigade level for large scenarios. Aircraft are typically handled individually or grouped into flights of four homogeneous aircraft. Naval assets are tracked individually. Ground unit attrition is accomplished using a weapon/target specific methodology that accounts for ground vehicles sensor capabilities, lethality, and vulnerability. Air defense simulation includes netted target acquisitions, Tel allocation, missile and equipment availability checks, and Monte Carlo damage/kill assessments. Naval attrition is evaluated using Monte Carlo draws after the individual target has been detected and engaged. Air/land/naval C3I including reconnaissance and intelligence asset management, intelligence fusion, communications network, and C-2 centers are explicitly modeled. Air/land/naval logistics including consumption and resupply of munitions, POL, and general supplies are also explicitly modeled.

CONSTRUCTION:

Human Participation: Required for gaming decisions. COMMANDER V simplifies this process by being totally menu-driven and providing a series of battle management displays such as computer-generated color terrain maps, available asset lists, and situation reports. Courses of action are nominated for the gamers.

Time Processing: Dynamic, time-step, and event-step.

Treatment of Randomness: Sensor performance and kill evaluations for air and naval combatants are handled stochastically after calculations of these probabilities are made. Land attrition is treated deterministically.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Not currently configured to model political and psychological warfare or the effects of chemical and nuclear weapons.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Work is under way to improve sensor and electronic countermeasure capabilities.

INPUT: Required data for weapon systems includes sensor capabilities, lethality, vulnerability, mobility, logistical requirements, repairability, and sustainability. Force structures must be assembled, C3 relationships must be established, and environmental data such as terrain and weather conditions must be entered.

OUTPUT: Complete time history with summaries for major mission areas such as air strike results, air defense effectiveness, and ground unit movement and attrition. Graphical results such as FLOT traces are also available.

HARDWARE AND SOFTWARE:

Computer:	Currently running on VAX series with VMS.
Storage:	2 MB main memory on VAX, 50 MB storage for data base.
Peripherals:	Ramtak or Tektronix graphics device and line printer.
Language:	SIMSCRIPT II.5, FORTRAN.
Documentation:	Documentation update in progress.

SECURITY CLASSIFICATION: Model source code is unclassified.

GENERAL DATA:

Data Base: Preparation time is typically 2 to 6 man-months.

CPU time per Cycle: Approximately 2 hours of CPU per day of battle.

Data Output Analysis: Postprocessor is available to sort through output file and generate summary statistics.

Frequency of Use: In almost continual use and development.

Users: Used primarily by SAIC in support of a variety of commercial and government customers.

Comments: N/A.

TITLE: COMMCOST 3.0 - COMMONALITY COST MODEL.

DATE IMPLEMENTED: June 16, 1990.

MODEL TYPE: Analysis.

PROPONENT: Joint Integrated Avionics Working Group, ATF SPO, WPAFB, OH 45433, and Commander, Naval Air Systems Command, AIR-524 (Cost Analysis Division), Washington, DC 20361.

POINT OF CONTACT: Bill Redden, Information Spectrum, Inc., 5107 Leesburg Pike, Suite 1800, Falls Church, VA 22041, (703) 845-3000.

PURPOSE: The model is used for analysis. COMMCOST is a menu driven LCC model that explicitly evaluates the impact of commonality on cost effectiveness of alternative aircraft equipment.

DESCRIPTION:

Domain: Air.

Span: Local.

Environment: Cost.

Force Composition: Up to 100 aircraft types, 80 bases.

Scope of Conflict: Conventional.

Mission Area: Costing concerns.

Level of Detail of Processes and Entities: 100 aircraft types, 80 bases. Logistics modeled with some resolution.

CONSTRUCTION:

Human Participation: Required for decisions and continue to run without a decision.

Time Processing: Static.

Treatment of Randomness: Direct computation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: COMO III - Air Defense Computer Modeling System.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Systems Analysis and Evaluation Office, U.S. Army Missile Command, Redstone Arsenal, AL 35898-5060.

POINT OF CONTACT: Charles E. Colvin, (205) 876-1333, AV 746-1333.

PURPOSE: COMO III is a general-purpose critical event modeling system designed for the writing and development of air defense simulations. It is used to evaluate the operational effectiveness of air defense weapon systems in a realistic tactical scenario. COMO III is used as a research and development tool and an operations support tool.

DESCRIPTION:

Domain: Land and air.

Span: Theater, corps, division, battalion, individual fire unit.

Environment: Electronic battlefield, digitized terrain, meteorological visibility.

Force Composition: Mix of land-based air defense weapon systems and mix of attacking airborne threat and tactical missiles.

Scope of Conflict: Conventional.

Mission Area: All conventional missions of an attacking airborne threat and tactical missiles.

Level of Detail of Processes and Entities: Single aircraft, tactical missile or air defense fire unit.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Event step with some time-step events.

Treatment of Randomness: Stochastic using both direct and Monte Carlo computation.

Sidedness: Two-sided, asymmetric with one side nonreactive.

LIMITATIONS: Initial setup of game requires large number of labor hours, excessive CPU hours for large-scale scenario, reactive and smart ECM not played, and wild-weasel tactics not simulated for aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Real-time battlefield graphics display package.

INPUT: Tactical scenario, weapon characteristics, ECM, weather effects, fire unit deployment, firing doctrine, rules of engagement, and defended ground assets.

OUTPUT: Computer printouts, plots, raw data, event-by-event summary, multiple replication statistics, and kill summaries.

HARDWARE AND SOFTWARE:

Computer: CDC 7000 series, CYBER 74, VAX 11/700 series, DEC MicroVAX, DEC 8000 series, GOULD, HP 9000, UNIVAC.

Storage: 160 K octal for nonvirtual memory computer.

Peripherals: 1 VT100 terminal and 1 high-speed printer.

Language: FORTRAN 77

Documentation: Fully documented.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Minimum 0.5 man-year, maximum 6 man-years.

CPU time per Cycle: Variable.

Data Output Analysis: Variable depending on level of expertise of analysts.

Frequency of Use: Continuously.

Users: TRADOC, MICOM, CAA, AMSAA, USA MSIC, numerous contractors.

Comments: COMO III is managed by the MICOM COMO Model Management Board.

TITLE: COMO(T) - Computer Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: USAADASCH, ATTN: ATSA-CSD-CM, Ft. Bliss, TX 79916-0002.

POINT OF CONTACT: Mr. Tom Crow, AV 978-2304.

PURPOSE: COMO is used primarily for air defense systems effectiveness analysis, but may be used to perform analysis in the areas of systems development, mix, doctrine, deployment, and employment.

DESCRIPTION:

Domain: Land and air with limited naval application.

Span: May represent from individual to theater.

Environment: Terrain relief, weather, time of day, electronic countermeasures, and IR countermeasures are available for selection by the user.

Force Composition: Component, RED and BLUE.

Scope of Conflict: Primarily conventional, but some nuclear and chemical warfare effects possible.

Mission Area: Air defense.

Level of Detail of Processes and Entities: Entities are typically modeled to the individual fire unit or platform level. The subsystems which compose the fire unit are simulated in great detail. For example, the functions of air defense systems are simulated for search, detection, track, engagement decision, launch, fly-out, burst, and kill assessment.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time-step and event-step model.

Treatment of Randomness: Stochastic with Monte Carlo draws.

Sidedness: Two-sided, symmetrical.

LIMITATIONS: Allows for only 4096 players concurrently in the simulation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: COMO is currently undergoing a total redesign to allow for a user-friendly environment in the areas of weapon system simulation and scenario data base generation.

INPUT: Terrain, weapons, movement, performance characteristics, static locations, ECM, IRCM, weather, time of day, and number of players.

OUTPUT: Computer printouts, plots, and raw data to drive post execution graphics. Postprocessor available.

HARDWARE AND SOFTWARE:

Computer:	Any 32 BIT computer.
Storage:	3.5 MB.
Peripherals:	Minimum requirements: 1 printer, 1 terminal.
Language:	FORTRAN

Documentation: Extensively documented in numerous published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:
Data Base: Depending on scale and level of detail desired, development can vary from man-hours to man-weeks.

CPU time per Cycle: Dependent upon data base sizes and systems being modeled.

Data Output Analysis: Postprocessing aids in analysis of output data.

Frequency of Use: In constant use by most users.

Users: USAADASCH, USA TRADOC, USAAMC, USAMICOM, CALL STC, AND USAMSIC.

Comments: Managed through a modeling resources group.

TITLE: COMO-T ADC3 - COMO-T Air Defense Command, Control and Communications Model.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Missile & Space Intelligence Center (MSIC).

POINT OF CONTACT: Director, U.S. Army Missile & Space Intelligence Center Attn: AIAMS-TAS (Donald P. Shepherd), Redstone Arsenal, AL 35898-5500, Comm (205) 876-7858; AV 746-7858.

PURPOSE: The purpose of the COMO-T ADC3 simulation is to model Soviet Air Defense Systems in war games ranging in complexity from one-on-one to many-on-many. The model is a critical event, general purpose Monte Carlo combat Model for simulation of air and ground warfare. The model realistically portrays the C3 functions as encountered in combat, such as loss of C-3 nodes, communications and handover errors between echelons.

DESCRIPTION:
Domain: Land and air.

Span: Accommodates up to theater level but has better fidelity at Army and Division level.

Environment: Utilizes Defense Mapping Agency (DMA) digitized terrain elevation data and can be used anywhere DMA data available. Simulation can model day or night operations with proper input data.

Force Composition: Joint and combined forces, red and blue.

Scope of Conflict: Primarily conventional warfare but could be modified for limited nuclear and chemical effects.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Modeler can model down to an individual gunner for a manpads system (SA-14/16) or fire unit (SA-13) level. There is also option to model attrition zones (used for large numbers of highly mobile systems). The model captures all of the system functions but not at the engineering level of detail. Attrition for aircraft/air defense assets are probability of kill, Monte Carlo based and output can be tailored to users needs.

CONSTRUCTION:
Human Participation: Not required-not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic-Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Currently developed for Soviet air defense system analysis, only minor work done for Free World systems for Third World scenarios. Limited to 4096 combat units.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Continued upgrading of pre-and postprocessor. Development of Soviet strategic air defense systems and Free World air defense systems weapon decks. Upgrade model to incorporate DMA feature data. Update all documentation.

INPUT: Location on battlefield, designation of communication links and coordination centers, detection probabilities ECM capability, target selection policy, munitions selection policy, reaction times, engagement boundaries, system reliability, etc.

OUTPUT: Detection attempts, ACQ ranges, missile intercepts, attrition, etc.; can be tailored for user specified output.

HARDWARE AND SOFTWARE:

Computer:	Computer code is transportable to most machines, currently running on a SUN workstation, VAX, CDC, HP, Apollo workstation, Cray, Gould.
Storage:	20 Megabytes minimum.
Peripherals:	1 printer, 1 graphics terminal.
Language:	FORTRAN.
Documentation:	Four volumes published but needs updating.

SECURITY CLASSIFICATION: Unclassified code but data bases are classified.

GENERAL DATA:

Data Base: MSIC maintains a data base for all Soviet air defense systems that is available to all who have proper need-to-know.

CPU time per Cycle: Highly scenario and machine dependent. Example: 866 combat units; 2000 SEC game time; 6 repetitions; Machine: CDC Cyber 860; CPU time: 2.42 hr

Data Output Analysis: Postprocessor aids in analysis of output. Produces hardcopies and floppies/cartridge tapes of parameters specified by modeler.

Frequency of Use: In continuous use and development at MSIC. Use varies at other commands.

Users: MSIC, JEWC, AVSCOM.

Comments: Takes 6-12 months to perform study with assistance from experienced users if starting from scratch. A COMO users group maintains configuration control of the COMO-T frame. Users merge weapon decks (aircraft, air defense systems red and/or blue), scenarios and rules of the game with the frame to model their specific problems. The model is Government-owned and was developed by MSIC to analyze Soviet air defense. The model has a wide range of applications, such as realistic C3 modeling, system effectiveness analysis, mission planning, employment/deployment analysis, force structure evaluation, firing doctrine development, battle management algorithm development and evolutionary concept evaluation. The model utilizes independent weapon system models that are modular in design which simplifies the creation of new models and the maintenance of current models. The independence of models allows for the simulation of many different systems in a combat situation and the evaluation of synergistic effects of the systems.

TITLE: ConMod - Conflict Model.

DATE IMPLEMENTED: In development, Beta test version available FY89.

MODEL TYPE: Analysis and training.

PROPONENT: Conflict Simulation Laboratory, Lawrence Livermore National Laboratory, P.O. Box 808 L-315, Livermore, CA 94550.

POINT OF CONTACT: John J. Rhodes, ConMod Project Leader, (415) 422-6550, FTS 532-6550 or Dr. Ralph M. Toms, Developments Project Manager, (415) 423-9828, FTS 543-9828.

PURPOSE: ConMod is a research and evaluation tool that can deal with weapons systems development or effectiveness and force capability and requirements and combat developments. ConMod is designed to support training for team skills development and to serve as an exercise driver at all levels from the small units to the Corps.

DESCRIPTION:
Domain: Land and air assets. The simulation is data base-driven so that the user can change data to emulate systems that are not explicitly modeled without recompilation.

Span: ConMod simulates force sizes from small units to Corps level at item-level resolution.

Environment: Digitized terrain from DMA or other data bases for elevation with cultural features overlay. Roads and rivers are explicitly modeled. Model allows for daytime and limited nighttime play. Weather can be changed but remains constant during the simulation.

Force Composition: Joint and combined forces, RED and BLUE.

Scope of Conflict: Conventional, advanced conventional, beam and nuclear weapons, and limited chemical effects.

Mission Area: All conventional and nuclear land operations.

Level of Detail of Processes and Entities: It is designed to support automated command and control of tactical units. Movement plans are automatically generated but can be reviewed and altered interactively by an analyst. Acquisition is performed at the unit level, but attrition occurs at the item system level. Attrition is stochastic: direct fire attrition is item system against item system, while indirect fire attrition is by individual artillery round against item systems.

CONSTRUCTION:
Human Participation: Designed to be used with varying levels of human participation from nearly fully automatic (little human participation) to intensive human interaction.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: Phased development restricts functionality as function of calendar year.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Phased development.

INPUT: Terrain file, pH/pK file, user-defined symbol file, and scenario file. Scenario file contains all system and unit characteristics. User can change model data.

OUTPUT: Real-time graphical, interactive graphics-aided postprocessing, and printed output.

HARDWARE AND SOFTWARE:

Computer: Although ConMod is compatible with any of the family of DEC VAX computers, at least a VAX 8800 is recommended. Uses the VMS 5.0 operating system.

Storage: Minimum requirement: 100,000 disk blocks. Typical configuration will require 300,000 to 500,000 disk blocks. Includes both executable programs and a minimal set of data files. Large scenarios and large output files on the order of 100,000 blocks.

Peripherals: Minimum requirement: one Tektronix 4225 workstation(minimum of two for two-sided interactive play) with one graph tablet and one VT100 or compatible terminal. Can expand up to eight workstations with two graph tablets each. Printer not required but very useful.

Language: VAX Ada.

Documentation: Design documentation and user's manual.

SECURITY CLASSIFICATION: Code is unclassified code but data bases may be classified .

GENERAL DATA:

Data Base: Creation of new data bases may take from one man-day up to several man-months depending on size and complexity.

CPU time per Cycle: Depends on scenario.

Data Output Analysis: The user determines which data is to be output to disk. Some reports can be printed, but the rest are read into files for processing through the INGRES data base management system on a graphics-based postprocessing system.

Frequency of Use: Will vary by installation.

Users: Lawrence Livermore National Laboratory, U.S. Army.

Comments: ConMod is a multi-year program with phased operation capabilities.

TITLE: CORBAN - Corps Battle Analyzer.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis (potential for FTX driver).

PROPONENT: U.S. Army TRADOC, FLVN, Ft. Leavenworth, KS 66027-5200.

POINT OF CONTACT: BDM Corporation: Earl Williamson, (703) 848-6327.

PURPOSE: CORBAN was developed explicitly to add the elements of doctrine, maneuver, and the attack of rear areas to the analysis of corps-level battle. It is a research and evaluation tool suitable for assessing overall weapon system effectiveness (as opposed to performance) as well as doctrine and operational tactical issues.

DESCRIPTION:

Domain: Land with air support missions.

Span: Corps-sized area: 3.5 km hexagonal terrain blocks.

Environment: Hex-based. Forestation, urbanization, roads, and rivers.

Force Composition: Treat all elements of corps AirLand Battle.

Scope of Conflict: Conventional, chemical, and nuclear warfare. Asymmetric battle; maneuver breakthrough and attack of fire support and service support explicitly treated.

Mission Area: AirLand Battle doctrinal defense of a corps area.

Level of Detail of Processes and Entities: CORBAN treats units down to detachment level although most units are treated as battalion or batteries. Terrain is represented by 3.5 km diameter hexes. Each processing cycle, each entity reloads its target array through the unit-on-unit detection logic. It then re-evaluates its mission based on the force ratio within its detection perimeter. Based on the template-level orders with the BLUE or RED doctrine file, the unit will decide if it must alter its mission or make request to its superiors. The decision to alter a unit's mission or to request fire support or supplies is communicated subject to delays imposed by unit-level suppression and jamming. The entity will fire on enemy units one weapon-target combination at a time, allocating fire according to a mixture of target value and target opportunity. If the mission requires movement, the entity will move in increments of 250 meters toward its objective at the highest speed allowed by the operation and the terrain. Entities may be lower than battalion for special units, and the time-step is variable.

CONSTRUCTION:

Human Participation: A set of orders must be prepared in advance to govern the actions of both sides. These orders are similar to real orders in that they contain the mission, objective, attachment, and priorities for fire support and resupply. If necessary, additional orders can be entered at one of the scheduled break points in the simulation.

Time Processing: Dynamic, time-step. There may be different levels of time-step for attrition, battalion decisions, brigade and regiment decisions, etc.

Treatment of Randomness: A small subset of model actions are random, most significantly the stochastic detection of one entity by another. Attrition is deterministic.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Because there is no terrain elevation, line of sight from hex-to-hex (3.5 km) is probablistic. Weapon types are counted in fractional units but are positioned in groups. For example, each tank does not necessarily have a unique position.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Some range dependency for attrition and detection at the weapon level, and some terrain and activity dependence in unit-on-unit detection.

INPUT: Terrain data, weapon fire control capabilities characteristics, unit detection capabilities, basic doctrine, and reactions of battalion and brigade/regiment-sized units, order of battle, and orders for major units.

OUTPUT: Killer-victim scoreboards, unit positions, strength, missions, and an "audit trail" of unit decisions.

HARDWARE AND SOFTWARE:

Computer:	Micro-Vax.
Storage:	10-20 MB for data.
Peripherals:	Printer, terminal, and plotter.
Language:	FORTRAN with the MIDAS preprocessor.
Documentation:	Latest documentation is April 1986.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Preparation of a new scenario takes two to four man-months given an existing terrain data base, doctrinal unit actions, and reactions data base.

CPU time per Cycle: For a typical scenario, the model runs more than five hours of combat for one hour of Micro-Vax time.

Data Output Analysis: A postprocessor produces briefing material.

Frequency of Use: See below.

Users: The Tactical Systems Analysis Directorate of BDM Inc. in McLean, VA, runs the model 12-20 times per year for the Defense Nuclear Agency, the U.S. Army, and the other customers. The model is also in use at other BDM offices, at the Training and Doctrine Command, and with major deployed forces in Europe and Korea.

Comments: N/A.

TITLE: Correlation of Forces Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Soviet Analysis Section, Ground/Frontal Forces Branch, DIA, ATTN: DB-1B3, Washington, DC 20340.

POINT OF CONTACT: Mr. Jeffrey D. Mazero, (202) 373-4069, AV 243-4069.

PURPOSE: The model allows the comparison of RED and BLUE ground and air forces in terms of combat potential.

DESCRIPTION:
Domain: Ground and air.

Span: Theater, regional, local (to division level).

Environment: N/A.

Force Composition: Combined ground forces; air forces.

Scope of Conflict: Conventional and nuclear.

Mission Area: N/A.

Level of Detail of Processes and Entities: Entities: Air force squadrons, ground force regiments/brigades, divisions. Processes: The model compiles combat potential points for each unit, aggregates the total, and develops a force-to-force ratio.

CONSTRUCTION:
Human Participation: Required for scenario setup.

Time Processing:. Static.

Treatment of Randomness: Deterministic.

Sidedness: Unknown.

LIMITATIONS: The model is not dynamic.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Force projections for RED and BLUE 1995 tables of organization and equipment.

INPUT: Scenario.

OUTPUT: Printout.

HARDWARE AND SOFTWARE:
Computer: Zenith 386.
Storage: 2 MB of RAM, 40 MB physical storage hard drive.
Peripherals: Printer and EGA monitor.
Language: Clipper DBase 3 dialect.
Documentation: In-house documentation only.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:
Data Base: DIA data base and data questionnaires.

CPU time per Cycle: Scenario dependent.

Data Output Analysis: Scenario dependent.

Frequency of Use: Varies.

Users: DB-1B3

Comments: N/A.

TITLE: COSAGE V - Combat Sample Generator.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Mr. John Warren, (DSN) 295-1690 or (301) 295-1690.

PURPOSE: COSAGE is a computerized combat assessment/weapons effectiveness mode which develops information on ammunition expenditures and losses of personnel and equipment during a 24 to 48-hour period of combat. The principal application is the forecasting of personnel, ammunition, and equipment requirements.

DESCRIPTION:
Domain: Land and air.

Span: Division area of operations.

Environment: When terrain parameters are required, the model randomly selects a terrain type based on statistical analysis of the region of interest. These parameters are then used to determine line of sight, movement rates, etc. Night and day are modeled, and visibility varies by time of day.

Force composition: Combined arms army, including helicopters and close air support.

Scope of conflict: Conventional warfare.

Mission area: Most of the mission areas associated with conventional combined arms are represented, with the exceptions of logistics and intelligence.

Level of detail of processes and entities: Maneuver unit resolution is typically down to Blue platoons and Red companies. In the case of close combat, resolution is to the level of individual equipment or personnel and their weapons, with each direct fire shot modeled explicitly.

CONSTRUCTION:
Human Participation: None.

Time processing. Dynamic, event-step.

Treatment of randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Electronic, biological, chemical, and nuclear warfare are not modeled, nor military operations in built-up areas. Logistics and intelligence functions are not represented.

PLANNED IMPROVEMENTS AND MODIFICATIONS: No major improvements are planned.

INPUT: Unit organizations, strength, and weapons; orders for each maneuver unit; weapons data (single shot probability of kill, lethal area); sensor capabilities; terrain parameters; movement rates; artillery organization and characteristics.

OUTPUT: Killer-victim scoreboard, personnel losses, ammunition expenditures by shooter/target combination, materiel losses, and unit locations on plot by time.

HARDWARE AND SOFTWARE:

Computer(OS): UNISYS 1100 series, with Exec 8. Has also been installed on various machines with UNIX operating systems.

Storage: 420K words of memory for model and data.

Peripherals: Line printer.

Language: SIMSCRIPT II.5.

Documentation: Combat Sample Generator User's Manual, DTIC B070095L. Combat Sample Generator Program Maintenance Manual, DTIC B073013L.

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:

Data Base: 6 man-months required to acquire data, plus 3 man-months required to structure data in model input form.

CPU time per Cycle: 90 minutes on UNISYS 1100 for 24 simulated hours.

Data Output Analysis: 1 month.

Frequency of Use: Support for 10 to 15 studies a year.

Users: U.S. Army Concepts Analysis Agency.

Comments: COSAGE is linked to the following models: FORCEM (Force Evaluation Model), CEM (Concepts Evaluation Model), WARF (Wartime Replacement Factors), and WARS (Wartime Ammunition Rates System).

TITLE: COSAM - Cosite Analysis Model.

DATE IMPLEMENTED: 1975, revised periodically, last major revision 1986.

MODEL TYPE: Analysis.

PROPONENT: ECAC.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 261-2355.

PURPOSE: COSAM is a research and evaluation tool used to determine cosite interference levels between communications equipment including hopping transmitters and receivers.

DESCRIPTION:

Domain: Any small area; e.g., ship, aircraft, tactical operations center, etc.

Span: Local area.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Communications systems on a platform or in close proximity to each other.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: Static.

Treatment of Randomness: Stochastic-Monte Carlo and Deterministic-using expected values.

Sidedness: One-sided.

LIMITATIONS: Up to 30 hopping transmitters and receivers can be analyzed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional equipment types (radars, EW systems, etc.).

INPUT: Equipment data and configuration of equipment defined with input data file.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1182, EXEC 8 operating system; VAX with VMS.
Storage:	2 MB
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	User's Manual, ECAC-UM-86-009-.

SECURITY CLASSIFICATION: Unclassified program, data and results may be classified.

GENERAL DATA:

Data Base: Communications data equipment parameter file derived from measured data and technical manuals.

CPU time per Cycle: Depends on problem - minutes and possibly an hour for hopping problem.

Data Output Analysis: Must understand cosite analyses.

Frequency of Use: Used frequently by ECAC engineers.

Users: ECAC, NOSC and others.

Comments: Developed as an in-house capability and recently ported to other users.

TITLE: COSYCAT - Combat System Capability Evaluation Tool.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.J. Ondrish, (301) 231-2097.

PURPOSE: This Standard Missile (SM) Weapon System analysis tool was designed to help engineers and analysts perform parametric studies of the capabilities of the system.

DESCRIPTION:

Domain: Sea.

Span: Local area.

Environment: At sea; any time; weather not considered.

Force Composition: One ship with SM.

Scope of Conflict: Conventional warfare.

Mission Area: AAW.

Level of Detail of Processes and Entities: This model consists of interactive graphics and associated weapon system modeling programs resident in a desktop computer. Modeling and program inputs include target and ship weapon system characteristics, including the following: reaction time distributions for radar assignment, acquisition, release, and redesignation: weapon direction system engageability algorithms based on Vitro's SM simulations: threat data including target flight trajectory such as radar cross section, height, speed, dive angle, aerodynamic slowdown, FCS and search radar range and envelope limits, and FCS range rate limit.

CONSTRUCTION:

Human Participation: Required to run interactive graphics.

Time Processing: Dynamic, time- and event-step.

Treatment of Randomness: Algorithms include consideration of results of many Monte Carlo runs of SM trajectory.

Sidedness: Two-sided, SM and target (aircraft or missile).

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Target and SM system characteristics.

OUTPUT: Graphical and tabular output indicating capabilities of the Total Standard Missile Weapon System.

HARDWARE AND SOFTWARE:

Computer: HP 9845C.
Storage: N/A.
Peripherals: Printer.
Language: HP Basic.
Documentation: Notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Has 2000 lines of code in model.

CPU time per Cycle: Four minutes or less.

Data Output Analysis: Hardcopy and graphics.

Frequency of Use: Occasionally.

Users: Vitro uses COSYCAT in support of NAVSEA for firing guidance (TARTAR SM).

Comments: For parametric studies, the characteristics of other missile systems and targets are easily modeled into the program.

TITLE: COVART II - Computation Of Vulnerable Area and Repair Time.

DATE IMPLEMENTED: September 1986.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: COVART II is used to calculate vulnerable areas and repair times for single penetrators (fragments or projectiles) impacting on the target skin within a preselected weight and speed matrix.

DESCRIPTION:

Domain: Abstract.

Span: Individual.

Environment: N/A.

Force Composition: Element.

Scope of Conflict: Conventional.

Mission Area: N/A

Level of Detail of Processes and Entities: COVART II can be used to analyze both aerial and ground targets. Each penetrator is evaluated along each shotline, and the contribution made along that trajectory to component and target vulnerable areas and to the repair effort are determined. Whenever a critical component is impacted by the penetrator, the probability that the component is defeated is computed using input conditional probability-of-kill given a hit data.

CONSTRUCTION:

Human Participation: Not required.

Time Processing:

Treatment of Randomness: Deterministic.

LIMITATIONS: COVART does not model exploding penetrators, blast effects, ricochet, or spall. Shotlines are assumed to be parallel.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: The COVART inputs include LOS files, critical component identification for each attack direction, component material type and thickness, threat type, Pk/h values, and threat velocity.

OUTPUT: COVART reports on vulnerable areas, presented areas, repair times, fault trees, and probability-of-kill given a hit.

HARDWARE AND SOFTWARE:

Computer: VAX and MicroVAX.
Storage: 80 KB.
Peripherals: N/A
Language: FORTRAN IV.
Documentation: COVART II User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: CRASOF - Combat Rescue and Special Operations Forces.

DATE IMPLEMENTED: No date; it simply evolved.

MODEL TYPE: Analysis.

PROPONENT: CINCMAC Analysis Group, HQ MAC/AG, Scott AFB, IL 62225.

POINT OF CONTACT: CAPT John McKoy, (618) 256-3450, AV 5776-3450.

PURPOSE: The CRASOF model examines the air assets necessary to conduct SOF and combat rescue missions. The model was developed to estimate the relative capabilities of a force under various strategies in order to maximize its capability.

DESCRIPTION:

Domain: Land and air.

Span: Best suited for global, theater, or regional conflicts.

Environment: Models virtually any type of SOF or rescue aircraft and selects the best available aircraft for the mission. Also models utilization and attrition rates, threat capabilities, combat radii, weather limitations, day or night operations, and air refueling.

Force Composition: Any combination of air refueling and airlift assets.

Scope of Conflict: Primarily suited for large conventional wars such as the Defense Guidance planning scenario but can be applied to any level of conflict.

Mission Area: Aircraft conduct missions into three different threat levels (high, medium, low) and three major areas of the air battle (DCA, CAS OCA/AI).

Detail of Detail of Processes and Entities: Individual aircraft grouped in minimum unit sizes are located at specific geographical coordinates. Individual downed aircrews and insertion/extraction/resupply locations for SOF teams are chosen randomly by latitude and longitude in areas of the air battle. The closest capable aircraft available to accomplish a mission is selected and air refueling requirements are then computed. Aircraft attrition rates are randomly applied against each mission and additional rescues are initiated for any attrited rescue or SOF airlift asset.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Aircraft availability and utilization rate reductions, mission objective locations and effectiveness, tanker attrition, mechanical aborts, and weather delays are some of the stochastically modeled events. Mission arrivals are deterministic.

Sidedness: One sided.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Input files require geographical coordinates of air battle areas, aircraft bed-downs, aircraft capabilities, force size and locations of SOF, and rescue air assets. The number of SOF and rescue missions required by day or phase of conflict must also be input.

OUTPUT: A comprehensive report of all mission activities for a specified number of replications of the conflict.

HARDWARE AND SOFTWARE:

Computer:	Concurrent 3260 with OS32 operating system.
Storage:	Minimum of 232K.
Peripherals:	1 printer.
Language:	FORTRAN 77.
Documentation:	Substantial documentation including user's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Basic scenario setup takes several man-days. Minor variations require several man-hours.

CPU time per Cycle: Varies. Minutes to hours of CPU time depending upon the length of conflict and number of aircraft, missions, theaters, and replications.

Data Output Analysis: Report shows statistics for each mission area (infil, exfil, etc.) and for each type of aircraft in theater. The daily minimum, maximum, mean, and total observations are shown as well as the standard deviation for each statistic.

Frequency of Use: Used frequently to answer questions on SOF and rescue capability.

Users: MAC.

Comments: None.

TITLE: CRUISE_Missiles - C-Based Routines for Understanding Interaction Between Ships, EW, and Missiles.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Naval Research Laboratory, Tactical Electronic Warfare Division, Code 5750, Washington, DC 20375.

POINT OF CONTACT: Dr. Gerald E. Friedman, (202) 767-3337.

PURPOSE: The CRUISE_Missiles model is used primarily to measure the effectiveness of various EW techniques against existing and postulated RF antiship missiles.

DESCRIPTION:

Domain: Naval antiship missile defense scenarios.

Span: Considers the terminal defense region local to the ships.

Environment: Detailed model of multi-path and clutter based on sea state.

Force Composition: Generally used with a ship, onboard ECM, one or more decoys, and one or more RF-guided antiship missiles.

Scope of Conflict: RF-guided antiship missiles (SS-N and AS).

Mission Area: Terminal defense against RF antiship missiles.

Level of Detail of Processes and Entities: Models missiles at the subsystem level using differential equations that represent in complete detail subsystems such as airframe, autopilot, RF seeker, and signal processing. The radar return for each pulse retains the intrapulse details. Ship and chaff targets are represented as range-distributed, statistically fluctuating radar cross sections. Active EW systems are also modeled. Missiles, ships, chaff, and countermeasures interact on pulse-by-pulse basis.

CONSTRUCTION:

Human Participation: Required for setting up the engagement scenario and initiating the simulation.

Time Processing. Event-driven mechanism. The events are transmit pulses of missiles. Dynamic equations representing the various subsystems are numerically integrated using the Euler method, with the interevent duration as the time-step.

Treatment of Randomness: Stochastic. There is provision for repeating a number of missile attacks and for performing a Monte Carlo analysis.

Sidedness: Two-sided, symmetric model with threats interrogating targets using RF pulses and targets responding with a radar return signal. The model represents threats (antiship missiles) against targets (ship, chaff, and ECM).

LIMITATIONS: The collection of threat and target models is not comprehensive. Simulation execution speed does not currently support real time operation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: New missile airframes and signal processing techniques are being added. Spatially distributed ship models with traceability to ship structures are being developed. Execution speed is being improved by porting model to a mini-supercomputer.

INPUT: Consists of missiles and targets that make up an engagement scenario. The missiles and targets are, in turn, specified by their component subsystems, which can be mixed and matched to form new entities.

OUTPUT: The user can select crucial variables in the missile and target subsystems and display them in x-y plots. A two-dimensional representation of the scenario showing the evolving location of targets, missiles, and their range gates is also available. Results of Monte Carlo are automatically saved to disk files for later analysis.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX computer with VMS. Planned additional availability under UNIX on a mini-supercomputer.
Storage:	6 MB of disk storage for source files and data.
Peripherals:	Tektronix 4014 graphics terminal or equivalent.
Language:	"C" and FORTRAN.
Documentation:	Draft copy of an NRL Report describing the model.

SECURITY CLASSIFICATION: Secret, although some parts are unclassified.

GENERAL DATA:

Data Base: Model does not use a data base, but preparing detailed subsystems for a new missile may take several months.

CPU time per Cycle: On a DEC VAX/VMS system, the model takes one minute to simulate one second of a missile-ship engagement.

Data Output Analysis: Monte Carlo runs automatically generate formatted report. Other runs produce hardcopy of graphics display.

Frequency of Use: Used daily at NRL Code 5750.

Users: NRL Code 5750 uses entire model; other groups including NRL, NSWC, PMTC, NAVAIR, and NWC use major subsystems.

Comments: CRUISE_Missiles is being incorporated as major constituent in a multi-sided, multi-reactive Naval theater warfare simulation facility being established at NRL.

TITLE: CSOX - Combat Support Operations Exercise.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Training and Education.

PROPONENT: Air Command and Staff College.

POINT OF CONTACT: MAJ D.A. Novak, DSN 493-6671, Comm (205) 953-6671.

PURPOSE: CSOX is a seminar exercise driver which simulates the effects of logistics planning and decision making on the combat readiness and life-cycle costs of notional military systems. The objective of CSOX is neither the conquest of territory nor the destruction of enemy units. Each team seeks to maintain the readiness of their own weapons systems and return broken equipment back to service as quickly as possible.

DESCRIPTION: (manual exercise)

Domain: Acquisition and logistics processes.

Span: Notional countries.

Environment: N/A.

Force Composition: Notional joint forces.

Scope of Conflict: Situation cards used to determine performance levels (readiness levels) required by specific conventional forces.

Mission Area: N/A.

Level of Detail of Processes and Entities: Weapon system units (i.e., a helicopter, a frigate, etc.).

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-stepped exercise.

Treatment of Randomness: Six-sided die cross-referenced with MTBF/MTTR tables.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Acquisition and Logistics processes extremely simplified to conduct exercise with non-area experts.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The exercise will be automated to run on desktop computers to lessen enormous amount of stubby pencil work.

INPUT: Projected requirements, notional acquisition and development costs, failure and repair rates, repair levels are all tied together to create an Integrated Logistics Plan (ILSP).

OUTPUT: Actual failure and repair rates are evaluated to determine if ILSP requires modification.

HARDWARE AND SOFTWARE: The exercise is currently a manual exercise. Future versions, FY93, will be computerized for PC play.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Notional, static data base.

CPU time per Cycle: N/A.

Data Output Analysis: Raw data computed by players.

Frequency of Use: Once a year.

Users: Air Command and Staff College, Combat Support curriculum phase of study.

TITLE: CSSTSS - Combat Service Support Training Simulation System. Version 1.0.

DATE IMPLEMENTED: None.

MODEL TYPE: Training and Education.

PROPONENT: U.S. Army Combined Arms Support Command; Attn: ATCL-LTJ, Fort Lee, VA 23831.

POINT OF CONTACT: Mr. Al Damour, AV 687-4822, Commercial (804) 734-4822 and/or Mr. Joe Riley, Avn 687-5993, Commercial (804) 734-5993.

PURPOSE: CSSTSS 1.0 is an exercise driver used to stimulate exercise play for the collective training of AC and RC commanders and staff personnel in command, control and communications. The training audience includes the CSS commanders and staffs in Echelons Above Corps, Corps Support Commands, and Division Support Commands as well as their subordinate headquarters. CSSTSS 1.0 initial product is used as a Command Post Exercise Driver. Subsequent CSSTSS products will be used as Command and Staff Trainers and Seminar Trainers.

DESCRIPTION:

Domain: Surface, air, water, rail.

Span: Will accommodate any theater depending on data base.

Environment: Can operate on 24-hour basis regardless of terrain, weather or terrain cultural features.

Force Composition: Primarily U.S. Army forces but can accommodate, other U.S. services and allied forces on a limited basis.

Scope of Conflict: Primarily supports conventional warfare, but some limited nuclear and chemical effects possible.

Mission Area: Support of all conventional land warfare.

Level of Detail of Processes and Entities: CSSTSS consists of eight separate, inter-active subsystems and two battle drivers. The Rear Operations Battle Driver is used to selectively inject combat events in the vicinity of CSS units while the Close/Deep Operations provides a force on force model for the combat units.

1. Within the Supply and Services functions, supply consumption and resupply are addressed. All classes of supply are considered and the means of determining consumption is based on realistic factors and tracked down to the stock number/line item level of detail.

2. Combat operations and random failures are the source of workload for the Maintenance subsystem, including both ground and aviation vehicles. Workload production is initiated when the training audience decides which maintenance facility will repair the damaged equipment and makes arrangements with transportation to get it there. Production is tracked by work order and can be transferred between maintenance facilities.

3. The Transportation subsystem a he training audience to train in the use of four modes (surface, air, water, rail). Management of cargo is at the transportation control number level of detail

4. The Personnel subsystem tracks the individuals by grade and MOS within each unit in the force structure and will degrade unit capabilities based upon personnel shortage.

5. The Medical subsystem interfaces with the combat driver and also calculates disease non-battle injuries. Hospital assignments, evacuation and patient transfers (done by the training audience) are covered and the subsystem will track patient time in the hospital based upon the typo wound and will return them to duty or evacuate them based upon theater policy.

6. The Graves Registration subsystem supports the GPREG training audience in monitoring remains processing functions and coordinating the movement of remains.

7. The Ammunition subsystem provides the capability to maintain visibility of played ammunition items by DODIC, account code, and condition code throughout the division, corps and theater army areas.

8. The POL subsystem supports the POL training audience in maintaining data on each POL storage and distribution facility and accounting for storage capacity, quantity on hand, issues, receipts, and products which have been destroyed or contaminated.

CONSTRUCTION:

Human Participation: Required. Human participation is required by the Training Audience to make decisions and by the Exercise Control Group for processing.

Time Processing: Dynamic, both time- and event-stepped.

Treatment of Randomness: Both stochastic and deterministic.

TITLE: CVOF - Ceiling/Visibility Observation and Forecast Simulation Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: United States Air Force Environmental Technical Applications Center (USAFETAC), Environmental Simulation Section. USAFETAC/DNY, Scott AFB IL 62225-5438.

POINT OF CONTACT: Capt Anthony J. Warren, DSN 576-5412, Commercial (618) 256-5412.

PURPOSE: CVOF is a weather simulator. Specifically, CVOF simulates both observations and forecasts of ceiling and visibility for a number of locations. It can be used to evaluate system effectiveness, force capability and requirements, and combat development by providing realistic weather scenarios to larger scale simulation models.

DESCRIPTION:

Domain: The model provides ceiling and visibility data as observed at the surface.

Span: Global. Many locations can be considered simultaneously. The model preserves the observed spatial and temporal correlation structures and generates forecasts with realistic skill.

Environment: Serves as an environment sub-model to larger scale simulation models.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Model provides observations and forecasts of ceiling height and visibility for a large number of specified locations. The time increment between observations is also specified.

CONSTRUCTION:

Human Participation: Not required, but is permitted.

Time Processing: Dynamic, time-stepped model. A fixed time-step is not required.

Treatment of Randomness: Stochastic. The model uses Monte Carlo methods to produce synthetic observations and forecasts of ceiling heights and visibility. The four-dimensional Boehm Sawtooth Wave model is used to generate fields of spatial and temporally correlated random numbers.

Sidedness: One-sided.

LIMITATIONS: Model limited to observations and forecasts of ceiling and visibility. Other weather variables are not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Modeling coefficients of the ceiling and visibility distributions (by month and by hour) are required for each location. Cross-correlations of ceiling and visibility are also required.

OUTPUT: Program has numerous options to produce output in varying forms. It is designed primarily to provide weather data to larger scale simulation models.

HARDWARE AND SOFTWARE:

Computer (OS): Designed on an IBM mainframe running the MVS operating system, but written in ANSI-standard FORTRAN specially to enhance portability to other computers and operating systems.

Storage: 240 Kilobytes.

Peripherals: None required.

Language: ANSI-Standard FORTRAN 77.

Documentation: USAFETAC/TN-89/002, CVOF (Ceiling and Visibility Observation and Forecast) Program Users Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Model coefficients are prepared by USAFETAC. Processing time is minimal.

CPU time per Cycle: Dependent upon the number of locations and the desired time-step. A 36-month simulation for hourly observations at 15 locations required 3.6 minutes of CPU.

Data Output Analysis: Model provides summaries of the frequency of occurrence of various ceiling and visibility thresholds during the simulation.

Frequency of Use: Model has had limited use since its inception.

Users: Primary user has been Air Force Center for Studies and Analysis.

Comments: The accuracy of the simulated forecasts is based on the average Air Weather Service bias in ceiling and visibility forecasts.

<u>TITLE</u>: CWASAR Cruise Weapon Analysis Simulation and Research.

<u>DATE IMPLEMENTED</u>: 1983.

<u>MODEL TYPE</u>: Analysis.

<u>PROPONENT</u>: McDonnell Douglas Missile Systems Company, P.O. Box 516, St. Louis, MO 63166.

<u>POINT OF CONTACT</u>: John FOX, (314) 233-0663.

<u>PURPOSE</u>: CWASAR models a BLUE force of TASMs and tactical aircraft carrying air-to-ground weapons, which attack RED force ships. CWASAR analyzes the survivability and effectiveness of the BLUE force in support of engineering analyses for weapon system development, and the development of tactical doctrine, such as effectiveness of a mix of weapon systems against targets.

<u>DESCRIPTION</u>:

<u>Domain</u>: Air and sea.

<u>Span</u>: Theater or regional.

<u>Environment</u>: Any sea area.

<u>Force Composition</u>: BLUE force TASM cruise missiles and tactical aircraft; RED force ships with SAM and gun defensive systems.

<u>Scope of Conflict</u>: Conventional weapons.

<u>Mission Area</u>: Defense suppression and target damage.

<u>Level of Detail of Processes and Entities</u>: Missiles (BLUE and RED), aircraft, and air-to-surface weapons (Harpoon, HARM, bombs, Walleye) are represented individually and are modeled with three or more degrees of motion. Radar performance models include radar range equation, multipath, sea clutter, and ship superstructure masking. The Tomahawk cruise missile model is the engineering tool used to develop TASM guidance and attack logic, and is the standard simulation against which all other TASM simulations are validated. The HARM model includes all guidance and attack logic modes. Attrition stops motion. Damage to a necessary component suppresses a system. For example, the loss of a SAM radar suppresses that SAM system.

<u>CONSTRUCTION</u>:

<u>Human Participation</u>: User plans scenario and creates input files. No human interaction during a simulation run. A postsimulation graphics replay program uses a file produced during the run to display the scenario dynamically. A user can stop and restart the replay, adjust the running speed, and zoom and pan the display.

<u>Time Processing</u>: Dynamic, time-step.

<u>Treatment of Randomness</u>: Stochastic, Monte Carlo.

<u>Sidedness</u>: Two-sided, asymmetric. RED force is reactive; BLUE force is partly preplanned and partly reactive.

<u>LIMITATIONS</u>: Maximum of 50 cruise missiles, 50 BLUE aircraft, and 25 RED ships.

<u>PLANNED IMPROVEMENTS AND MODIFICATIONS</u>: RED force additions: carrier-based interceptor aircraft. Rehost to VAX/VMS.

INPUT: BLUE and RED force weapon characteristics, TASM engagement plans, BLUE aircraft flight plans, and RED ship classes and locations.

OUTPUT: Computer file outputs with target damage assessment, BLUE force attrition, RED force attrition, detailed time history of events, and graphics replay. Postsimulation graphics replay program provides dynamic color graphics display of strike area showing moving vehicles, targets, and flight plans. Statistical report program provides effectiveness and survivability information.

HARDWARE AND SOFTWARE:

Computer:	Harris 1000 or 1200 system; Harris VOS operating system.
Storage:	Approximately 5 MB or main (virtual) memory and 10 MB of disk storage, depending on level of output detail requested.
Peripherals:	Tektronix 4115 or 4125 graphics terminal.
Language:	FORTRAN 77 with Harris extensions.
Documentation:	Simulation catalog entry (15 pages), model description (96 pages), user manual (63 pages).

SECURITY CLASSIFICATION: Secret. (Nearly all code is unclassified, a small number of subprograms are secret or confidential.)

GENERAL DATA:

Data Base: Several days for a new scenario; less if working from an existing scenario.

CPU time per Cycle: Depends on scenario size. One case of 20 TASMs and 7 RED ships took 14 CPU hours for 50 Monte Carlo iterations. There are other ways in which the simulation can be run in less time for specific applications.

Data Output Analysis: Depends on the purpose of the analysis. A statistical report program is available.

Frequency of Use: Used monthly.

Users: Used in studies performed for the Cruise Missile Program Office Advanced Systems Group. McDonnell Douglas internal users include Tomahawk development, test flight planning and analysis, and Harpoon.

Comments: Utilizes radar performance data generated by SALRAM, another McDonnell Douglas simulation. Enhancements are ongoing. Simulation is certified by the Cruise Missile Program Office.

TITLE: CWTSAR - Chemical Warfare Theater Simulation of Air Base Resources.

DATE IMPLEMENTED: 1982 (CWTSAR I); 1986 (CWTSAR II).

MODEL TYPE: Analysis.

PROPONENT: AL/CFHD, Wright-Patterson Air Force Base, OH 45433-6573.

POINT OF CONTACT: Dr. C.R. Replogle, DSN 785-7583, Commercial (513) 255-7583.

PURPOSE: CWTSAR is a Monte Carlo discrete event simulation model of air base sortie generation operations in a CW environment for one or more air bases. A CWTSAR simulation consists of multiple trials, each spanning several days of air base operations and representing a complete Blue and Red scenario. CWTSAR (developed by JAYCOR) incorporates the effects of chemical warfare into the existing framework of TSAR (developed by RAND Corporation).

DESCRIPTION:

Domain: Land.

Span: Local.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: Conventional and chemical warfare.

Mission Area: Air base operations.

Level of Detail of Processes and Entities: CWTSAR is a Monte Carlo discrete event simulation model representing tactical aircraft sortie generation processes in a wartime environment on air bases subject to conventional and chemical attacks. A system of interdependent theater air bases, supported by shipments from CONUS and by intra-theater transportation, communication, and resource management systems. The simulation permits decision makers to examine the interdependencies among 11 classes of resources as they affect the sortie generation rates. The effects of battle damage from enemy air attacks using conventional and chemical weapons and the results of restorative operations can be assessed.

CWTSAR represents the following chemical warfare effects: chemical casualties, thermal effects (thermal casualties, work/rest cycles), task performance degradation, Detection, Identification, and Warning (DIW) effects--protective posture change, decontamination effects, collective protection effects. CWTSAR tracks people individually; tracks general attributes: personnel type and work shift, location (both on and off-duty), activity level (resting or working), specific job assignment (if working); tracks CW related attributes: protective posture level and condition, individual chemical casualty status measures, individual thermal casualty status measures.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Extensive data requirements, restrictive work shift representations (12 hours on, 12 hours off), limited representation of aircrew operations and air base support processes, no individual tracking of aircrews, only tactical aircraft operations simulated, no measures of the effectiveness of sorties flown.

INPUT: Air base descriptors, air base resources, task networks, mission tasking, attack data (resource loss data, runway/taxiway hits lists, chemical challenge history data), chemical warfare factors, miscellaneous simulation data.

OUTPUT: Primary air base operations measures (sortie generation data, personnel casualty data), secondary air base operations measures (air base activities summaries, resource constraint data, aircraft maintenance summaries, runway/taxiway availability), raw simulation data.

HARDWARE AND SOFTWARE:
Computer(OS): VAX computer with a VMS operating system.
Peripherals: None required.
Language: FORTRAN 77.
Documentation: Limited.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: From days to weeks.

CPU time per Cycle: Dependent on data base size. Usually between 2 and 12 hours.

Data Output Analysis: Extensive output.

Frequency of Use: According to contract requirements.

Users: JAYCOR.

Comments: Model developed by JAYCOR, Dayton, Ohio, under USAF contract to AL/CFHD, WPAFB, OH.

TITLE: D2PC - Downwind Chemical Hazard.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: CRDEC, Studies & Analysis Office, Aberdeen Proving Ground, MD 21010-5423.

POINT OF CONTACT: Mr. C. Glenvil Whitacre, (301) 671-4241, AV 584-4241.

PURPOSE: D2PC is used to estimate downwind hazard from chemical agent munitions. It also conducts hazard analysis of alternate operation plans and predicts hazard zones in the event of accidental release.

DESCRIPTION:
Domain: Land: flat terrain (open and woods).

Span: Local; downwind hazard extent of cloud for chemical cloud transport and diffusion.

Environment: Spectrum of expected meteorological conditions.

Force Composition: N/A.

Scope of Conflict: Chemical safety.

Mission Area: Transport and storage of chemical munitions.

Level of Detail of Processes and Entities: A modified Gaussian model is used to predict downwind hazard distances in terms of concentration and accumulated total dosage. Program considers variations in meteorology and atmospheric stability. It evaluates chemical agent spills, functioning munitions, and heated stack plumes. Stability changes are permitted from stable to less stable conditions.

CONSTRUCTION:
Human Participation: Highly user-interactive.

Time Processing: Static; total dosage estimations only.

Treatment of Randomness: Deterministic.

Sidedness: N/A.

LIMITATIONS: A rather coarse approach is used to characterize chemical cloud transport and diffusion through woods. Model lacks a technique to assess chemical cloud transport and diffusion through urban terrain. Improved assessment techniques for variable state meteorology are needed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Automate source estimates for fire-related release situations and add a large-scale release capability.

INPUT: The program is designed to be user friendly for simulation of accidental releases that could occur at chemical storage sites. The input is selected from menus such as site location, munition type, agent type, terrain, and meteorological parameters. The program extracts needed input parameter values from internal data base tables. Nonstandard combinations of inputs may also be defined on input.

OUTPUT: The basic output is a downwind estimate of hazard distance to "no effects," "no deaths," and "1% lethalities" based on total dosage exposure.

HARDWARE AND SOFTWARE:

Computer:	IBM-compatible PCs, UNIVAC 1100/60 system.
Storage:	Approximately 1800 lines of code.
Peripherals:	Minimum requirement: one printer.
Language:	ASCII FORTRAN (Standard FORTRAN 77).
Documentation:	User's guide, Personal Program for Chemical Hazard Prediction (D2PC), CRDEC-TR-87021, and handbook in draft form (not yet published).

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minimal time requirements for input. Time used to answer input questions varies from several seconds to several minutes, depending on choice of available default options.

CPU time per Cycle: CPU time from one to several seconds.

Data Output Analysis: No postprocessor is available for analysis of output data. It is not, however, necessary because of the simplicity of the output.

Frequency of Use: Depending on user, it is used from many times per day to just several times per year.

Users: Broad spectrum of users through U.S. Army, U.S. Air Force, U.S. Navy, government agencies, environmental agencies, contractors, and others.

Comments: D2PC has been developed and maintained by the Studies & Analysis Office of CRDEC since 1974. Handbooks for use are available, and training classes are held from time to time upon request.

TITLE: DAMS - Division Ammunition Management Simulator.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Ordnance Missile and Munitions Center and School, Attn: ATSK-CTA, Redstone Arsenal, AL 35897.

POINT OF CONTACT: Mr. Leon Jones, (205) 876 8420/8493, AV 746-8420.

PURPOSE: DAMS is used to analyze the impact or organizational (e.g., new TOEs) and structural (e.g., physical and geographical positioning) changes upon an ammunition supply node.

DESCRIPTION:

Domain: Abstract.

Span: Local.

Environment: Day/night operations.

Force Composition: Any from company through corps.

Scope of Conflict: Anything desired.

Mission Area: Ammunition logistics.

Level of Detail of Processes and Entities: Degree of resolution is the individual ammunition DODIC. All organizational details of an ammunition supply node (TP, ASP, CSA, or TSA) are portrayed and affect the throughput of ammunition. Degradation factor is introduced for night operations. Demand upon the supply point is generated by external sources (usually TRADOC Standard Scenario Task Organization).

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Convoy generation is deterministic (no randomness). The remainder of the model is stochastic (direct computation). The model can be run in Monte Carlo mode.

Sidedness: One-sided.

LIMITATIONS: Maximum of 25 line items of ammunition portrayed, no more than material handling equipment (MHE), maximum of 60 Field Storage Units.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The development of a preprocessor is being considered.

INPUT: Unit force structure, types and quantities of trucks, scenario length, data collection intervals, data elements to collect, and ammunition unit organization (people and MHE).

OUTPUT: Plots and printouts of ordered, organized data and statistics.

HARDWARE AND SOFTWARE.

Computer: IBM PC compatible with math coprocessor operating in MS-DOS.
Storage: 20 MB.
Peripherals: Printer.
Language: FORTRAN.
Documentation: Ammunition Point Simulation (APS) User/Programmer Manual (Books 1 & 2), Armament Systems, Inc., Feb 83 and Division Ammunition Management Simulator (DAMS) User/Programmer Manual, Strategic Financial Planning Systems, Inc., Dec 87.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Averages 90 minutes, but could take much longer depending on the degree of revision.

CPU time per Cycle: Seven-day run in 60 minutes.

Data Output Analysis: Hardcopy printouts containing data flagged in the input process. Some statistical analysis completed by postprocessor.

Frequency of Use: Often used daily but on the average used weekly.

Users: OMMCS.

Comments: N/A.

TITLE: DAP - Data Analysis Package.

DATE IMPLEMENTED: November 1988.

MODEL TYPE: Analysis.

PROPONENT: CA1 Division, RARDE, Fort Halstead, Sevenoaks, Kent, England.

POINT OF CONTACT: PO/EWS, CA1 Division, RARDE, Fort Halstead, Sevenoaks, Kent, England. Tel: Knockholt (0959) 32222 Ext 3253.

PURPOSE: DAP is a data base system designed to process the output from the Electronic Warfare Simulation (EWS).

DESCRIPTION:

Domain: Abstract.

Span: N/A.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: DAP is designed to extract data meeting user-defined criteria from the EWS data retrieval models. Data may be extracted on individual units, groups of units meeting specified criteria, and particular types of EW or communications equipment. Message histories may also be extracted via the message log processor.

CONSTRUCTION:

Human Participation: Required to interrogate the data base.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: Cannot process EW intelligence data from the EWS.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Inclusion of output from the intelligence gathering model.

INPUT: Logging files from the EWS data retrieval models.

OUTPUT: On-screen display, printout, or computer file of unit status; communications configuration; EW equipment performance with time; and computer file of unit identities and locations for input to Macintosh interactive display and analysis system (MIDAS).

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with VMS operating system.
Storage:	Minimum requirements: 2.5 MB main memory (12 MB ideal) and 100,000 blocks (5 MB) disk space.
Peripherals:	Minimum requirements: one VT100 terminal and one printer.
Language:	VAX FORTRAN 77, DCL, and RAPPORT DBMS.
Documentation:	User guide, system description, and programmer guides.

SECURITY CLASSIFICATION: Classified.

GENERAL DATA:

Data Base: One-half man-day to load a new study run onto DAP.

CPU time per Cycle: Depends on data base size.

Data Output Analysis: Output file for input to MIDAS. Output files for input into Macintosh spreadsheet (EXCEL).

Frequency of Use: As required.

Users: RARDE.

Comments: N/A.

TITLE: DART Family of Survivability Models.

DATE IMPLEMENTED: 198?.

MODEL TYPE: Analysis.

PROPONENT: Defense Nuclear Agency, Washington, DC 20305-1000.

POINT OF CONTACT: Captain Mark Loepker, SAF, (703) 325-7405.

PURPOSE: A research and evaluation tool to assess the prelaunch survivability (PLS) of nonstrategic nuclear forces and to evaluate the relative effectiveness of PLS enhancements, changes in system design, and changes in operational characteristics on the overall system PLS.

DESCRIPTION:

Domain: Land, air, or naval operations with 3 separate models.

Span: Theater, regional, or local, depending on data base.

Environment: Not explicitly addressed. Implicit impact upon operations.

Force Composition: Land-based mobile systems, dual capable aircraft (DCA) airbases, or naval forces (including submarines and surface vessels) are portrayed depending upon the model selection.

Scope of Conflict: RED and BLUE conventional, unconventional, chemical, and nuclear.

Mission Area. Assesses system's prelaunch survivability while system operates in a manner appropriate for the given tension/hostility state.

Level of Detail of Processes and Entities: For naval systems, the data base defines numbers and type of naval vessels in terms of vulnerabilities, weapons, terminal defenses, torpedo attack tactics, and SAM parameters. Aircraft carriers are further defined by their unique capabilities. Submarines are given characteristics which allow them to operate in support, on ASW missions, or independently. Maritime patrol aircraft data must also be provided. For land-based mobile systems, the BLUE forces are viewed by the threat forces as target types grouped for the purpose of movement activities. The RED threat (which comes in the form of signal intelligence, satellite and aircraft reconnaissance, agents, special operations, counterbattery artillery, and air and missile strikes) is described by threat slice, search areas, detection probabilities, and kill probabilities. The dual capable aircraft/airfield model focuses on a single airbase whose configuration is described in terms of the number of assets (aircraft and weapons), and the number of dimensions of key facilities (runways, shelters, communications, and weapon storage facilities). In addition, the aircraft and mission parameters and the airbase's associated sortie generation activities are detailed in the data base. The base is subject to RED attacks from air, missile, and ground threats which are described by threat slice and kill probabilities against the base's assets and facilities.

CONSTRUCTION:

Human Participation: Required for processes (model is interruptable).

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, asymmetric, reactive model.

LIMITATIONS: Terrain, sea, and weather conditions must be implicit in operational data. Off-line effort may be required to create the data bases.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Follow-on contract will enhance future versions.

INPUT: A data base must define BLUE and RED forces, as well as activities both offensive and defensive associated with these forces. An entire schedule of events such as RED/BLUE deployment and engagements is user specified.

OUTPUT: The model provides a chronology of the events in both printed and graphical outputs. A simulation run produces a printout with varying degrees of detail (user specified) about BLUE and RED survivability. The graphical output provides plots of survivability of the BLUE and RED assets.

HARDWARE AND SOFTWARE:

Computer:	IBM or compatible (MS DOS).
Storage:	Hard disk or high-density drive required.
Peripherals:	Printer (laser or EPSON), EGA/CGA/XGA graphics card required for plotting.
Language:	Microsoft Quick Basic 4.0.
Documentation:	User manuals completed.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base development could take several weeks and require some expertise in terms of system and threat. However, variations of a data base are easily made using the models' editing programs.

CPU time per Cycle: Dependent on data base size and period of simulation. Individual simulation runs will take from 10 minutes to an hour.

Data Output Analysis: Printouts and graphics provide rapid analysis.

Frequency of Use: Varies by Command.

Users: SHAPE, AFNORTH, AFCENT, AFSOUTH, UKAIR, USEUCOM, USAFE, USAREUR, USPACOM, USPACFLT, USPACAF, WESTCOM, DNA, FC/DNA.

Comments: None.

TITLE: DCOR - Deterministic Combat Model of Oak Ridge.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis (but can be also used as an exercise driver/training model).

PROPONENT: Oak Ridge National Laboratory (ORNL), Oak Ridge, TN 37831-6363.

POINT OF CONTACT: Dr. V. Protopopescu, (615) 574-4722; Col. R.T. Santoro, (615) 574-6084; Dr. Y.Y. Azmy, (615) 574-8069.

PURPOSE: DCOR is designed to analyze quickly operations plans with a reasonable degree of accuracy. To serve in conjunction with detailed wargames and simulation models as an assessment and sensitivity analysis tool for mixes of forces, resources, and tactical decisions. The model can also be used in training, exercises, and new weapons assessment/acquisition.

DESCRIPTION:
Domain: Land and air.

Span: Essentially local, but depending on data base scales exceptionally well up and down.

Environment. Includes terrain relief. Light and weather factors can be indirectly included.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Primarily conventional, but nuclear, chemical, and smart weapons effects possible through indirect modeling.

Mission Area: Essentially all conventional missions and, to some extent, unconventional warfare (LIC, drug war, etc.).

Level of Detail of Processes and Entities: Typical lowest entity is platoon, but due to very good scaling properties, the model can go down to individual and up to brigade. In the first case there will be a discrepancy between the statistic interpretation of the distribution function and the actual density number. In the second case detail will be lost. Within a single run the operational levels should be roughly the same size. Attrition and movement directly described in all cases. Communications, logistics and intelligence can be indirectly taken into account by appropriate modeling.

CONSTRUCTION:
Human Participation: Not required, but possible. The model is interruptable, has capabilities for scheduled and interactive charges.

Time Processing: Dynamic, time-stepped. Event-stepping possible.

Treatment of Randomness: Attrition deterministically based on averaged Lanchester coefficients. The model computes deterministically functions that have statistical meaning (distribution functions).

Sidedness: Two-sided, symmetric. Can be extended to many-sided.

LIMITATIONS: Does not include detail similar to that found in wargames and stochastic models; inclusion of more detail lengthens the time of a run and defeats the main purpose of the model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhanced graphic and animation capabilities, faster PDE solver, and more flexible interaction.

INPUT: Terrain, attrition rates, velocity vectors, type and location of weapons, etc.

OUTPUT: Produces printouts of attrition and movement data, graphical display, and animation.

HARDWARE AND SOFTWARE:

Computer:	Essentially computer independent; DISSPLA, NAG, NCSA software.
Storage:	Minimum 10MB.
Peripherals:	Minimum requirements: Tektronix Terminal on workstation under Windows.
Language:	FORTRAN, C.
Documentation:	Documented in published papers and Oak Ridge National Laboratory Reports.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Relies on existing aggregated data base.

CPU time per Cycle: Dependent on situation. Usually takes minutes of CPU time to process hours of combat.

Data Output Analysis: Hardcopies of raw data, graphical displays, and animation.

Frequency of Use: Depends on purpose.

Users: MICOM.

Comments: Managed by ORNL. Continually upgraded.

TITLE: DECON - Electronic Warfare (EW) Frequency Deconfliction.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Larson (301) 267-2355, DSN 281-2355.

PURPOSE: DECON is an operational support tool that enhances frequency usage by predicting frequency conflicts resulting from the shared use of the spectrum by communication-electronics (C-E) and EW systems. The National Security Agency (NSA) generated Signal Operation Instructions (SOI), containing frequencies, call signs, and net information for VHF-FM Combat Net radio (CNRs) are loaded into DECON. DECON then searches the data base for duplicate assignments and conflicts with the Restricted Frequency List (RFL).

DESCRIPTION:

Domain: Land with limited air and sea operations.

Span: Regional analysis.

Environment: No environmental effects considered.

Force Composition: Combined forces.

Scope of Conflict: Conventional warfare.

Mission Area: Communications, SIGINT, and communication jamming mission.

Level of Detail of Processes and Entities: Net numbers, frequencies and call signs are assigned to units. If a conflict is found, spare frequencies can be assigned to the affected unit. Conflicts with the RFL can be resolved in the same fashion. Coordination with the affected units may also "resolve" conflicts by determining if the distance between units is large enough to preclude a conflict.

CONSTRUCTION:

Human Participation: Required to load SOI diskettes into data base, maintain RFL, and resolve conflicts by assigning spare frequencies.

Time Processing: Dynamic, normally daily time-steps.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Up to 1000 protected, taboo, or restricted frequencies in RFL. Location and terrain data is not used in DECON.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modify DECON data base to accept data from SOI diskettes, locally generated, using revised Battlefield Electronic (EOI/SOI System (RBECS).

INPUT: Data base requires SOI data to be manually entered or transferred, via NSA generated diskettes.

OUTPUT: Displays printouts of data and results. RFL can also be copied onto diskette for transfer to another PC data base.

HARDWARE AND SOFTWARE:

Computer: IBM PC Compatible (80286/386), MS-DOS 3.3 or higher.
Storage: 640KB RAM, Min 40MB hard disk.
Peripherals: 5 1/4" or 3 1/2" disk, laser or dot matrix printer.
Language: Fox Pro.
Documentation: User's manual/on-line help.

SECURITY CLASSIFICATION: Unclassified program, but SOI data may be classified.

GENERAL DATA:

Data Base: Population of large (10,000 net) data base will take 2-3 hours if loaded from SOI diskettes on 80286 or will take several days if manually entered.

CPU time per Cycle: Depends on data base size. Most runs take less than five minutes once data base is populated.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Daily/varies by user.

Users: ECAC, JEWC, 5th SIGCMD, Army CE Services.

Comments: Originally developed by ECAC for U.S. Army Communications Electronic Command for use in REFORGER exercises.

TITLE: DEEAL - Design Electronics Algorithm.

DATE IMPLEMENTED: 1987, revised 1991.

MODEL TYPE: Analysis.

PROPONENT: ECAC.

POINT OF CONTACT: R. Todd (301) 267-2556, DSN 281-2556.

PURPOSE: DEEAL is a research and evaluation tool used to determine cosite interference levels between radars and between communications transmitters and radar receivers.

DESCRIPTION:
Domain: Any small area; e.g., ship, aircraft, etc.

Span: Local area.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Radar and communications systems on a platform or in close proximity to each other.

CONSTRUCTION:
Human Participation: Not required and not permitted.

Time Processing: Static.

Treatment of Randomness: Deterministic-using expected values.

Sidedness: One-sided.

LIMITATIONS: Up to 30 radars and communications transmitters can be analyzed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Add more equipment types (radars, EW systems, etc.) and enhanced communication receiver analysis.

INPUT: Equipment data and configuration of equipment defined with input data file.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1182, EXEC 8 operating system; VAX with VMS.
Storage:	1.5 MB.
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	User's Manual ECAC-UM-87-046.

SECURITY CLASSIFICATION: Unclassified program, data and results may be classified.

GENERAL DATA:
Data Base: Communications equipment and radar parameter file derived from measurement data and technical manuals.

CPU time per Cycle: Depends on problems-usually 2 to 5 minutes.

Data Output Analysis: Must understand cosite equipment interference levels.

Frequency of Use: Used primarily by NOSC for shipboard radar analysis.

Users: NOSC and ECAC.

Comments: Mod?. developed by ECAC for NOSC.

TITLE: DEPLOY - Deployment and Sustainment Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Training and education.

PROPONENT: War Gaming and Simulation Center, Institute for National Strategic Studies, National Defense University (NDU-NSS-WGSC) Ft. McNair, Washington, DC 20319-6000.

POINT OF CONTACT: R.D. Wright, (202) 475-1251, AV 335-1251.

PURPOSE: To illustrate logistical constraints in deployment and employment planning. The model provides quick (less than five minutes) feasibility checks and tradeoff analyses for aggregate force deployments in support of academic exercises. Users balance theater requirements with available lift, set tradeoffs between unit arrivals and stock buildups and between deployed force elements and support slices.

DESCRIPTION: Deploy calculates either lift required for feasible arrival dates for as many as five different theaters. Unit lift requirements are defined for outsized and oversided/bulk unit equipment weights, possible support elements, and peacetime and wartime consumption. Theater data comprises distances and prepositioned stocks and available host nation support. U.S. and allied airlift and sealift assets are shown under various mobilization options. Users provide a prioritized force lists, supply levels and lift allocation. The model calculates support slice needs and arrival dates; or users provide required arrival dates for a force list and the model calculates support elements and required lift.

Domain: Intertheater air and sea lines of communication.

Span: Theater level deployments; no intratheater movement.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Divisions, brigades, and like-size army support elements; MEFs/MEBs, Air Force squadrons and wings. Naval units are not included.

CONSTRUCTION:

Human Participation: Force unit priority, theater supply level, and lift mobilization and allocation decisions.

Time Processing: One day time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: No CONUS transportation constraints; no intermediate air base throughput capability, no intra-theater lift. Simplified theater air and sea port capacity. The model generates optimistic results.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Data base revisions; partial treatment of CONUS and intermediate air base, through-put constraints.

INPUT: Units to be deployed (with priorities); supply level desired; either lift allocation to theater or required closure dates.

OUTPUT: Time Phase Force and Deployment List; theater stocks; support element balance, air (C-5 and C-141/CRAF) and sealift used.

HARDWARE AND SOFTWARE:
- Computer: An IBM-XT or Z-248/IBM-AT or clone with 512K byte, memory.
- Storage: Can run from a floppy disk.
- Peripherals: Printer.
- Language: FORTRAN.
- Documentation: Exercise and user's guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Additional theaters can be added in a day by an area-knowledgeable user.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use. Four multi-team exercises per year.

Users: NDU Industrial College of the Armed Forces, National War College, and Institute for Higher Defense Studies.

Comments: Source code maintained at NDU-NSS-WGSC.

TITLE: DESCEM - Dynamic Electromagnetic Systems Combat Effectiveness Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds, ATTN: [STEEP-T-E], Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: As an operational support tool (decision aid), DECSEM is used to determine expected message delay as a function of link availability, expected message length, average message arrival rate, and message service discipline.

DESCRIPTION:
Domain: Land, air, limited space, and naval.

Span: Accommodates any theater depending on the data base. Can model individual equipment systems to full corps and above deployments.

Environment: Communications.

Force Composition: Joint and combined forces, BLUE, GREY, and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: DESCEM models any type of communications system defined by communications links from single links to complex deployments. Traffic loading is in terms of messages that can represent either voice or data. Based on link status conditions and message profile descriptions, the model determines expected message successes and delays in terms meaningful to the communication system user.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Statistical.

Treatment of Randomness: Portions of DESCEM are probabilistic, others are deterministic.

Sidedness: Not applicable.

LIMITATIONS: Does not model propagation; results after propagation considerations provided as input.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Study work complete for adaption of U.S. Army Communications Data Base.

INPUT: Expected message length, average message arrival rate, message service discipline, and probabilities of successful link operations.

OUTPUT: Point and interval estimates of expected message waiting and completion times, expected message delays, and probability that message waiting and delay times will exceed specified time limits.

HARDWARE AND SOFTWARE:

Computer:	CDC CYBER 180 Model 830.
Storage:	Variable; requirements can be adjusted. Minimum memory is 30,100 octal words.
Peripherals:	Disk storage.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Dependent on analysis scope. With existing data bases, analysis requiring data modification for specific test system requires 1 to 2 months depending on system.

CPU time per Cycle: Dependent on deployment size and number of equipment to be evaluated. Corps size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts.

Frequency of Use: On demand, approximately once per year.

Users: Model is resident at USAEPG.

Comments: The model is not machine dependent. However, it takes advantage of the CDC CYBER 60-bit word for optimization of data storage and access and would require modification for othor environments.

TITLE: DETCONT - Detection Contour Program.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Atmospheric Sciences Laboratory, SLCAS-AE-AE, White Sands Missile Range, NM 88002-5501.

POINT OF CONTACT: Dr. Harry J. Auvermann, (505) 678-4224, AV 258-4224.

PURPOSE: DETCONT is a research and evaluation tool that deals with combat development. In addition, it deals with competing strategies of deployment and countermeasures to battlefield lasers. The model defines the boundary (the contour) of the region on a battlefield within which a given laser can be detected by a given sensor. The signatures evaluated are the radiation scattered from the port of the laser device and from the beam by airborne particulates. The model output would primarily be used in a war game to determine which opposing units were in position to detect and call in counterfire.

DESCRIPTION:
Domain: Land.

Span: Regimental battlefield.

Environment: Flat terrain, variable visibility, variable climate, variable illumination, variable background fluctuations.

Force Composition: Front-line units.

Scope of Conflict: Deployment, RED or BLUE, of laser rangefinders, designators, and weapons and deployment, RED or BLUE, of unaided observation, direct view optics, image intensifiers, and thermal viewers.

Mission Area: Suppression of battlefield use of lasers.

Level of Detail of Processes and Entities: The model calculates the position on the battlefield where an individual soldier will begin to detect the presence of a laser device with one of the sensors listed above.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Uniform battlefield conditions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrade to EOSAEL format.

INPUT: Weather, sensor, and laser data from ASCII files.

OUTPUT: Table-of-range and off-axis-angle pairs for each combination of interacting laser and sensor.

HARDWARE AND SOFTWARE:

Computer(OS): VAX 11/780 VMS.
Storage: 200,000 bytes.
Peripherals: Line printer.
Language: FORTRAN.
Documentation: Internal, users guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minimal time.

CPU time per Cycle: 20 seconds.

Data Output Analysis: None.

Frequency of Use: Inactive.

Users: ASL.

Comments: N/A.

TITLE: DETEC - Defense Technology Evaluation Code.

DATE IMPLEMENTED: Initial release at Los Alamos National Laboratory - Mar 88; Release 1 at National Test Facility (NTF), Falcon AFB, CO - Sept 88; Release 2, NTF - Dec 88; Release 3, NTF - Scheduled for Feb 89.

MODEL TYPE: Analysis - performance evaluation and system design of the SDS architecture.

PROPONENT: Paul Merillat, SDIO, RGO/POET, 1225 Jefferson Davis Highway, Suite 300, Arlington, VA 22202, (703) 685-6640/41.

POINT OF CONTACT: Martin Marietta ISG, NTB Division, M.S. N8200, Falcon AFB, CO 80912-5000, (719) 380-3500.

PURPOSE: DETEC is a simulation framework and set of functional models that together provide the capability to evaluate at a system level the concepts and components for the design of an SDS. The DETEC framework provides the modularity needed to integrate functional models with a wide range of capabilities and thus model a variety of SDS architectures.

DESCRIPTION: The DETEC framework includes six components: a Manager that provides a human engineering interface for simulation setup, observation, and interaction; an Executive that provides simulation control; a Mother Nature that updates the real-world environment; an Engagement element that simulates the battle; a Data Recording element that collects data for post-run analysis and display; and a Run Time Data Base composed of state vectors that characterize the simulated objects of the battle environment. Models include assets of the SDS and threat objects generated from STAMP or AURORA and ATTACK (future).

Domain: Land, sea, and space up to geosynchronous orbit.

Span: Theater or global conflicts.

Environment: Limited environment in Release 2. In future, models will reflect both natural environments and included environments.

Force Composition: Users can select from available BLUE assets, RED assets, and the RED threat. BLUE and RED assets currently include models of all SDS Phase I elements. RED threat options include SDIO-validated and user-defined threats, ASAT attacks, and penetration aids.

Scope of Conflict: Conventional and nuclear weapons.

Mission Are[illegible] SDS.

Level of [illegible] of Processes and Entities: Entity: The DETEC framework accommodates functional models of varying detail. Processes: Threats are not aggregated. Sensor models output angles only. Measurements (SNR error included) and irradiances are consistent with true sensor devices.

CONSTRUCTION:

Human Participation: Not required; model interruptable. Permitted to alter process or decisions.

Time Processing: Dynamic, discrete event.

Treatment of Randomness: Stochastic, direct computation and deterministic.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Release 3 planned for February 1989.

INPUT: User must build Asset Specification and Setup Parameters Files. User may select from available RED and BLUE assets and specify parameters for each asset selected or use the DETEC defaults. Help information is available to explain parameters. Typical asset parameters include quantity, type, location, field of view, range, lethality, yield required to kill, cycle time, propagation delay, etc. Threat options include ASAT attacks and penetration aids. Setup parameters include display and Mother Nature update, times, simulation stop time, initial seed for random number generator, and data logging options. Run time input options are limited to change display update time, Mother Nature update time, and continue execution time.

OUTPUT: Separate terminal-based graphical routines provide user-specified output of analyzed data. The computing network environment provides hardcopy, movie film, and microfiche of any output desired.

HARDWARE AND SOFTWARE:

Computer(OS):	Cray 2 Supercomputer, UNICOS Version 4 operating system.
Storage:	Several million words.
Peripherals:	Tektronix 4237 and 4337 Workstations and 4693D printer.
Language:	Cray FORTRAN, FORTRAN 77 with extensions.
Documentation:	NTB-237-003-11-02, DETEC Users Manual; NTB-237-003-12-02, DETEC Programmers Guide; NTB-237-003-13-02, DETEC Technical Reference Manual for Release Two; NTB-237-003-14-02, DETEC Function Description Manual for Release Two; DETEC Interface Control Document (to be released with Release 3); and others.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Time required to build a data base may vary from hours to days.

CPU time per Cycle: Depends upon size of threat.

Data Output Analysis: Can vary from minutes to hours to days.

Frequency of Use: Daily.

Users: SDIO, NTB Integration Contractor, and Joint Project Office.

Comments: N/A.

TITLE: DETECT.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: AL/CFHD, Wright-Patterson Air Force Base, OH 45433-6573.

POINT OF CONTACT: Dr. C.R. Replogle, DSN 785-7583, Commercial (513) 255-7583.

PURPOSE: As a postprocessor for TSARDOSE chemical challenge history, DETECT assesses detector network system performance and effectiveness for a wide variety of existing and developmental detectors and detector employment options. (NOTE: Any chemical challenge history in TSARDOSE format could be used as input.)

DESCRIPTION:
Domain: Land.

Span: Local; data bases can be set up for any area.

Environment: Simple terrain surface chemical detector response.

Force Composition: N/A.

Scope of Conflict: Chemical agent detector networks for Red or Blue units.

Mission Area: Air base operations.

Level of Detail of Processes and Entities: Resolution down to individual detector with response times, alarm and reset capability.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-step, and event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Communication network failures/errors not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modeling of communications/network characteristics, failure, and error rates.

INPUT: Chemical challenge history data, detector characteristics (sensitivity levels, agent capabilities, type, response time), network description (detector locations, communication times, detector polling scheme).

OUTPUT: Listing of detector status output.

HARDWARE AND SOFTWARE:
Computer(OS): Any system with a FORTRAN compiler.
Storage: 2MB.
Peripherals: None required.
Language: FORTRAN 77.
Documentation: User Guide, self-documented code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1 man-month for detector characteristics and network layout for a unit of air base size.

CPU time per Cycle: Dependent on input size (10 minutes to 1 hour).

Data Output Analysis: SAS routines produce statistical output in minutes.

Frequency of Use: According to contract requirements.

Users: JAYCOR.

Comments: Model developed by JAYCOR, Dayton, Ohio, under USAF contract to AL/CFHD, WPAFB, OH.

TITLE: DETERS - Defense Targeting Evaluation Resident on Sun.

DATE IMPLEMENTED: Current version 1988.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC), Engineering and Software Group, 6725 Odyssey Dr., Huntsville, AL 35806-3301.

POINT OF CONTACT: Mr. E.E. Hildreth, Commercial (205) 971-6743.

PURPOSE: DETERS is a theater level force-on-force Theater Missile Defense (TMD) effectiveness simulation used to assess TMD in the context of a joint land, sea, and air attack. Active and passive countermeasures are modeled in the simulation.

DESCRIPTION:
Domain: Land, air and sea operations.

Span: Theater, Regional, and Local, depending on the data inputs, and scenario used. No restrictions.

Environment: Currently environment factors relating to detection of assets and the terrain affecting force movements are modeled in the Red and Blue system parameters as probabilities of detection and rates of movement, etc.

Force Composition: Joint and combined forces, Red and Blue.

Scope of Conflict: Primarily conventional, chemical, and unconventional warfare. Passive and active countermeasures are included. Nuclear could be used, but currently other simulations are used for nuclear exchanges.

Mission Area: Theater Missile Defense.

Level of Detail of Processes and Entities: Offensive weapons are defined by their range, probability of reacquiring the assets, and lethality to the assets it attacks. Defensive weapons are defined by their range, probability of acquisition, multiple engagement capability, and their lethality to their target. Assets are defined by their mobility, probability of detection, vulnerability to weapons, and their recovery rates. Weapon platforms are defined by their range,vulnerability, and the weapons they carry. All definitions are two-sided; i.e., Red and Blue.

CONSTRUCTION:
Human Participation: Optional, can be automatic, or can be scripted. Model can be interrupted to allow human participation and decisions.

Time Processing: Dynamic, treats each Red/Blue and Blue/Red interchange as a cycle over x hours. Results are carried over to next cycle.

Treatment of Randomness: Deterministic, generates a value as a function of an expected values retrieved from the data base.

Sidedness: The model is two-sided and symmetric.

LIMITATIONS: Currently the model does not model close combat, nor does the FEBA move.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Add a geographic interface for rapid insertion of data, and for geographical displays of the data and battle results. Add FEBA movement. Currently a breadboard version of Dupuy equations (historically based) are in the model to allow for close combat, but this version has not been released.

INPUT: Weapon and asset (targets) characteristics, including coordinates, reliability, range, vulnerability, lethality, acquisition probabilities, and recovery times. Also included are attack priorities and weapon assignments. Inputs for both Red and Blue.

OUTPUT: Asset damage levels, defensive weapons used, and offensive weapon used and lost as a function of time. Outputs for both Red and Blue.

HARDWARE AND SOFTWARE:

Computer: SUN 3/80 computer with Unix operating system.

Storage: DETERS-11MB, Unify & P V WAVE-35MB.

Peripherals: Printer and graphic plotter.

Language: Ada.

Support Software: P V WAVE, and Unify (including Simplify).

Documentation: Users manuals and training course material.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Given data available, approximately one month to insert, verify, and checkout.

CPU time per Cycle: Five minutes or less.

Data Output Analysis:

Users: Used by SAIC and MHI to Support SDC and SDIO architecture studies in Japan and Korea.

TITLE: DEWCOM - Divisional Electronic Warfare Combat Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Force Modeling Division, Computer Applications Directorate, JEWC, San Antonio, TX 78243-5000.

POINT OF CONTACT: MAJ John R. Ferguson, (512) 925-2579, AV 945-2579.

PURPOSE: DEWCOM is a research and evaluation tool that focuses on the electronic combat environment in support of tactical ground and air operations. It analyzes communications, EW, and air defense employment concepts; assesses system and force mix; examines interoperability and joint and combined warfare issues; conducts combat and support force trade-offs; and interfaces with field test excursions.

DESCRIPTION:

Domain: Land and air; limited naval operations.

Span: Accommodates scales from individual to theater.

Environment: Uses DMA DTED for terrain relief. Weather and time of day considered in play of air forces and air defense systems.

Force Composition: Mix from system to combined forces level, BLUE and RED.

Scope of Conflict: Conventional, BLUE and RED.

Mission Area: Conventional missions include tactical air and ground operations; interdiction, defense suppression, support jamming in stand-off and self-protect modes; use of RPVs in a lethal or nonlethal mode; resupply; realistic communications environment; ground and airborne EW operations; intelligence gathering and dissemination among units; and air defense networks.

Level of Detail of Processes and Entities: User describes both the friendly and threat forces including infantry, armor, artillery, EW and support units, and air forces from an individual or aggregate level. User establishes a C3 structure by creating a link and net structure. Last, user issues a set of orders with stimulus for ground movement; air task orders; communications orders; and EW orders. User can use attrition to measure effectiveness of EW on the outcome of the battle. Ground warfare and logistics modeled at low resolution; communications, EW, air warfare, and air defense at high resolution.

CONSTRUCTION:

Human Participation: Not required, but model is interruptable.

Time Processing: Dynamic, time-step and event-step.

Treatment of Randomness: Stochastic, Monte Carlo determination of air, defense, and direct and indirect fire attrition based on computation of probabilities of damage and kill. Ground attrition deterministically based on modified Lanchester equation.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: No ship-to-ship fighting, naval mine warfare, or undersea operations (but naval gun support and naval air defense systems are modeled).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Air-to-air, chaff, and flare capability; more detailed postprocessor support; and enhanced graphics.

INPUT: Weapons; communications and EW equipment; units, terrain, combat, and communication organization; tactical, communication and EW orders; avionics; aircraft; corridors; air operations orders; air defense systems and organization; IR and RCS patterns; airborne jammer characteristics; RPV characteristics; SEAD data tables; and attrition tables.

OUTPUT: Formatted printouts of input data; reports on status of units, links, messages, equipment, EW operations; intelligence logs; attrition summaries; air and air defense statistics; plotter output of scaled terrain box (1:500000 or 1:250000); FLOT trace at specified time intervals; histograms of specified model activities; and graphics of unit locations during the battle.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX under VMS operating system or Data General, portable to any system with a SIMSCRIPT compiler.
Storage:	100,000 blocks for a division-level scenario.
Peripherals:	Printer, VT100 terminal, CALCOMP 1044 plotter and CGS4600 graphics terminal.
Language:	SIMSCRIPT II.5.
Documentation:	Executive summary, user's manual, DEC/VAX operator's manual, programmer's manual, and instructor's manual.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Usually six to nine months depending on level of complexity, but use of files developed by Users Group during scenario development can decrease time.

CPU time per Cycle: Usually one hour of CPU time for every two hours of combat in a division-level scenario. Playing air and air defense increases CPU time significantly because of high resolution.

Data Output Analysis: Quick Query Output file contains records of all simulation activities using code numbers as a key, specified by the user. Graphics postprocessors help analyze output.

Frequency of Use: Varies by command; used at least annually by those below.

Users: JEWC, JWC, Combat Developments Fort Bliss, and ARMTE White Sands.

Comments: Configuration control by JEWC with an established Users Group. Upgrades are based on priorities, funding, and consensus of the Users Group.

TITLE: DFSAM - Direct Fire Stand-Alone Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: CA4 Division, RARDE, Fort Halstead, Sevenoaks, England.

POINT OF CONTACT: N. Roberts, RARDE ext 2289.

PURPOSE: Research and Evaluation of weapon systems effectiveness.

DESCRIPTION:
Domain: Land.

Span: Local (typically up to 20km front).

Environment: Digitized terrain, representing relief, vegetation and man-made cover. 500m resolution.

Force Composition: Heterogeneous direct fire units, and "off table" artillery.

Scope of Conflict: Conventional.

Mission Area: Direct fire battle.

Level of Detail of Processes and Detail: Company (Red) vs. Troop (Blue). High-value units (e.g., LRGW) may be represented individually. Lanchester-based attrition. Movement is along preplanned routes, at speed governed by local going.

CONSTRUCTION:
Human Participation: Not required, but is permitted.

Time Processing: Partially time-sliced, partially event sequenced.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: No infantry; no C3I.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: 1) Weapon characteristics (range, time of flight); 2) Minefield and barrier data (location, mine density, etc.); 3) Orbat, deployment, routes, orders; 4) Systems data (DF SSKP data, minefield lethality, arty lethality).

OUTPUT: 1) Killer/Victim tables, by replication and averaged; 2) Mine and arty kills.

HARDWARE AND SOFTWARE:
Computer(OS): VAX/VMS.
Storage: 20 MB (40000 blocks).
Peripherals: Requires DEC VT100, VT200 or VT300 compatible terminal.
Language: FORTRAN 77.
Documentation: User Guide, Programmer's Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Preparation: several weeks.

CPU time per Cycle/Data Output Analysis: Preprocessor: Few CPU minutes; Simulation: approx 1 minute CPU time per minute of battle; Analysis Package: minimal. N.B. Timings are based on a complex main defensive action scenario.

Frequency of Use: Rare.

Users: CA4 Division RARDE.

Comments: DFSAM uses the same DF modeling as the Divisional War Game (DWG) from CA3, RARDE, and was originally intended to be used to replicate small elements of the DWG campaign & DFSAM normally uses systems data files created for DWG use. It is intended that the modeling link between the two models be maintained.

TITLE: DGTS - Dynamic Ground Target Simulator.

DATE IMPLEMENTED: 1986.

PROPONENT: USAF Rome Air Development Center.

POINT OF CONTACT: Center for EW/RSTA; Attn: AMSEL-RD-EW-SE (J. Mills or A. Slutsky); Fort Monmouth, NJ 07703; DSN 996-5782.

PURPOSE: Dynamic simulation of RF Sensor Systems in a multi-target, multi-sensor environment at echelons up to Division/Army.

DESCRIPTION:

Domain: Land and air.

Span: Accommodates any theater where DMA digitized map data and target/sensor laydowns are available.

Environment: Models terrain, road networks, RF path loss, communication networks, weather effects on mobility.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Primarily designed for electronic warfare, jammers, ESM sensors, radars, communication links, etc. Limited air-to-air; air-to-ground; and ground-to-air physical combat.

Mission Areas: Primarily IEW.

Level of Detail of Processes and Entities: The DGTS model is a dynamic simulator allowing the evaluation of individual RF sensors in a large-scale scenario. The model allows multiple red and blue targets and sensors to be modeled on airborne, ground vehicular or fixed site platforms. Targets can be movers and/or emitters (radar/comm). A distinctive feature of DGTS is the ability of the model to constrain ground movement to selected routes in the map data base's road network. The effects of jamming on RADAR or SIGINT type sensors can be evaluated. The specific terrain of the area being simulated can be included for sensor/target line of sight determination and road networks can be used to direct ground vehicle movements. Air-to-air and ground-to-air weapon performance can also be included. Formation configurations for ground and airborne forces can be specified and communication networks set up with specified rules of operation. Emitter transmissions can be operated either deterministically or on a statistical basis with duty cycle and mean and standard deviation of the transmission interval specified. DGTS can be dynamically linked to other models allowing the addition of more detailed sensor/target/weapon performance parameters to DGTS by internally generated commands. An operator can generate new orders as the simulation progresses but model inputs cannot be rapidly created.

Time processing: Dynamic, time-step model based on update intervals and command timeliness established in the order file. Model may run faster or slower than real time depending on simulation complexity and the time-steps that are chosen. For most model runs with a moderate target list (200-300) and 15 sec sensor update time-steps, DGTS runs 2-4 times slower than real time on VAX 11/780 (near real time on the 3100 workstation).

Treatment of Randomness: Events may occur on a deterministic or on a random basis.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Does not include detailed sensor/weapon performance modules. Detailed performance models can be linked to DGTS regardless of simulation language used. Original version was limited to the computation of free space RF path loss, but an upgraded version has been generated by linking DGTS to the TIREM RF path loss model to include atmospheric absorption, troposcatter, and terrain diffraction effects. DGT, as presently configured, is not suited to evaluate optical sensor performance.

PLANNED IMPROVEMENTS AND MODIFICATIONS: DGTS is being continuously modified to support various customer needs. The past DGTS has been linked to the TIREM path loss model and to the ESAMS air defense model. Future modifications may include the addition of sensor target location accuracy determinations and detailed EW sensor models.

INPUT: Equipment Performance Attributes (i.e., frequency range, transmit power, vehicle speed rage, etc.). Linkages between equipment/units (i.e., radars, comm, weapons on an aircraft). Scenario Order File (location/movement of units, emission time histories, etc.). Map Data Base (used DMA DTED files and digitized feature data).

OUTPUT: Screen map display of scenario events (movement, detections, target destruction, etc.), messages sent to another (subscriber) process giving important parameters (target/sensor position and range, received power, etc.) for key events such as target detections. Specialized codes can be written for the subscriber process to reduce the output data to the desired formats.

HARDWARE AND SOFTWARE:

Computer: Runs on VAX 11/780 and has been modified to run on VAX 3100 workstation.

Storage: Model itself requires only about 1.2 MBytes, but considerably more storage may be needed for the map data base used.

Peripherals: RAMTEK display required for viewing operation on VAX 11/780. No additional display needed on workstation. Need printer for hardcopy output.

Language: DGTS Executive is written in PASCAL, the model itself is written in MDL (a version of PASCAL) with an MDL compiler included with the model.

Documentation: A number of documents generated by the original developer, the PAR Corp, including: User Manual, Simulation Driver Integration, Kevin Trott and Frederick Frantz, December 1985.

SECURITY CLASSIFICATION: Unclassified (code).

GENERAL DATA:

Data Base: Software associated with DGTS allows the construction of map/attribute files. The generation of map feature files for large maps (using a map digitizer) or the creation of attribute files for large/diverse force levels can be time consuming. DGTS allows the generation of statistically based orders and the generation of orders for large units that will be followed by all subordinate elements that can speed up the order generation process.

CPU time per Cycle: Depends on simulation size, can run considerably slower than real time.

Data Output Analysis: Separate software packages linked to DGTS called subscriber processes can be used for concurrent or postprocessor analysis.

Frequency of Use: Used many times per year on various scenario simulations including pre-test planning.

Users: Center for EW/RSTA, USA CECOM, other Army users include TRAC/WSMR and AMSAA, for Air Force RADC.

Comments: Model is composed of 23 separate modules (i.e., ground movement, target acquisitions, etc.) which are linked together to produce an executable of about 1,200,000 bytes. A model executive and monitor routines are needed to run the model with an MDL compiler required to make any changes to the model. Other software is associated with the generation of the map (terrain and features data base) and the attribute files.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: DIDSIM - Defense-In-Depth Simulation.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Strategic Defense Initiative Organization (SDIO), The Pentagon, Washington, DC 20301-7100.

POINT OF CONTACT: Joan Vickery, (714) 768-8161.

PURPOSE: DIDSIM was developed as an effectiveness tool for SDIO architecture evaluations. It contains low- to medium-fidelity models of most of the weapons considered by SDIO and the battle management rules for their use. Each object in the threat is modeled.

DESCRIPTION:

Domain: Air and space.

Span: Global, regional, local, or individual, depending on data base.

Environment: Space.

Force Composition: Joint and combined forces, BLUE and RED sides.

Scope of Conflict: Nuclear and non-nuclear missiles and directed energy and nuclear particle beam weapons.

Mission Area: Strategic defense, near-term and far-term.

Level of Detail of Processes and Entities: Models each RED weapon (booster, PBV, RV) as a separate entity. Reads a threat file generated by the DIDSIM threat generator (EXOCET) to obtain individual state vectors. Objects are propagated on ballistic trajectories in space, and time-of-flight contours are used for atmospheric flight. Models each of the various weapon systems (kinetic energy weapons, ground- or space-based) and space-based directed energy weapons as individual entities. Models ground- and space-based sensors individually. All space-based entities move on Keplerean trajectories. A set of battle management rules for controlling all defense assets is contained in the simulation.

Interaction of the kinetic energy weapons is modeled as a random probability of kill. The directed energy weapon's irradiance on target is calculated as a function of geometry and accumulated until the kill fluence is achieved. Sensor field-of-view (range and angle) constraints are checked to ensure that objects have been detected, tracked, and discriminated before they can be engaged. Time delays are used to model the time line associated with these precommit functions. False alarm and leakage draws are made to model the discrimination process. Directed energy and neutral particle beam weapons can also be used as discriminators where the reaction of the device with each threat object is modeled. Models all phases of strategic attack, ASATS, boost phase, midcourse, and terminal.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic time based on event-steps.

Treatment of Randomness: Discrimination, kill probability, and kill assessment probability are modeled stochastically with Monte Carlo determination of results. Detection and tracking are treated deterministically.

Sidedness: Two-sided, asymmetric, one side nonreactive. RED reaction captured by the threat generation done off-line.

LIMITATIONS: Size of battle limited only by computer resources (core and run time).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Constantly being modified to handle additional architecture, rules of engagement, and weapon and sensor systems.

INPUT: Highly data base-driven. Threat is generated off-line. User must input time delays, kill probabilities, sensor and weapon parameters, numbers, locations, and orbital parameters for all entities.

OUTPUT: Output varies from high-level effectiveness data to detailed performance information on each weapon's individual engagements. Can be displayed graphically.

HARDWARE AND SOFTWARE:

Computer:	Runs on VAX, SUN, Convex, and HARRIS.
Storage:	DIDSIM is three separate simulations. The largest storage requirement is for MIDSIM (2 MB).
Peripherals:	1 printer, 1 laserjet printer, and 2-3 terminals.
Language:	FORTRAN 77.
Documentation:	User manuals.

SECURITY CLASSIFICATION: Unclassified, but threat data base can be classified.

GENERAL DATA:

Data Base: Can take extensive time to set up data base for new architectures.

CPU time per Cycle: Highly dependent on threat and architecture. Large threats take several CPU hours.

Data Output Analysis: Highly interactive postprocessor available for output analysis. In-line debug aids also available.

Frequency of Use: Used extensively by SPARTA to support SDIO architecture work.

Users: SPARTA, U.S. Army Strategic Defense Command.

Comments: DIDSIM is a family of simulations: ASATSIM, SBDEWSIM, and MIDSIM. Each can be used to generate data files for higher fidelity simulations.

TITLE: D/ITEM II - Defense/Interdiction and Targeting Evaluation Model II.

DATE IMPLEMENTED: 1984; revised in 1989.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Missile and Space Intelligence Center, Redstone Arsenal, AL 35898.

POINT OF CONTACT: Mr. James Foshee, (205) 876-5930.

DEVELOPER: Science Applications International Corporation, 6725 Odyssey Drive, Huntsville, AL 35806-3301.

POINT OF CONTACT: Ms. Tamara Mooring, (205) 971-6504.

PURPOSE: D/ITEM II was developed to assess the need for and contributions of candidate weapon systems in a combined arms theater environment. Uses include requirements analysis and system performance effectiveness evaluation for air, missile, rocket and artillery offense/defense systems and evaluation of tactical missile threat issues. D/ITEM II is a summary level, expected value, two-sided, cyclical model used to assess the dynamic interactions of theater warfare. Conventional, nuclear and chemical/biological munitions of land and sea based air (aircraft, helicopter, and cruise missile), tactical ballistic missile and artillery weapon systems are modeled.

DESCRIPTION:
Domain: Land and sea based air, missile and artillery weapon systems. Two-dimensional battle space.

Span: Theater level. Data bases include Central, Northern and Southern NATO Regions Europe, Western Pacific (Japan) and the Persian Gulf.

Environment: Geography modeled by zone and density (number of targets per zone); attack cycle simulated over time; models day and night; damage to transportation nodes affects migration rates; damage to C3 facilities affects system performance.

Force Composition: Combined arms, BLUE and RED.

Scope of Conflict: Conventional, Nuclear, and Chemical/Biological.

Mission Area: Broad range of scenarios; all possible weapon/target combinations are considered.

Level of Detail of Processes and Entities: Weapon systems are modeled to the squadron (number of aircraft per squadron), fire unit, or launcher level. Targets are modeled by individual element (number of like elements per zone), aggregated by up to 99 target types per side. Targets can be fixed (stationary), migrating (move towards the FLOT at a constant mi ration rate), or relocating (moving randomly to avoid detection). Target acquisition is a function of day/night, target radiating/non-radiating, moving/stationary, and depth from FLOT. A "Smart Planner" function dynamically allocates weapons to targets based on availability and effectiveness (includes range, command and control performance, time of flight, acquisition and kill performance). Air defense performance is a function of weapon type, zone in which the target is located, en route attrition, terminal defense doctrine and status of air defenses (mission availability, movement status, footprint size, calibration factor, command and control performance, single shot probability of kill, and maximum simultaneous engagement limits). Air defense systems modeled include surface-to-air missile (SAM) systems, anti-tactical missile (ATM) systems, dual-capable (SAM/ATM) missile systems, and air defense interceptor aircraft.

Air defenses can be layered. Armed reconnaissance and Special Operations Teams are modeled.

CONSTRUCTION:

Human Participation: User intervention is allowed between attack cycles to review cumulative simulation results and/or change various data base parameters.

Time Processing: Dynamic; expected value over time-stepped attack cycle. Typically six-hour attack cycles, four cycles per 24-hour simulated day.

Treatment of Randomness: Expected value based on weapon and target relative density per zone and input performance characteristics and effectiveness probabilities (availability, reliability, acquisition, reacquisition, and kill).

Sidedness: Two-sided (RED and BLUE). Asymmetric; weapon and target deployments unique per side; tactics not mirror-imaged.

LIMITATIONS: Terrain not explicitly modeled. No graphical output (computer printout tables only).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Contingency theater data base development. Graphical output.

INPUT: D/ITEM II preprocessor aids in data entry and review. Input parameters include offense, defense and fixed/mobile target operating/performance characteristics, acquisition and C3 capabilities, target priority, deployment and resource levels.

OUTPUT: Computer printouts; tables summarize various levels of simulation results, by cycle and cumulative.

HARDWARE AND SOFTWARE:

Computer: VAX 11/780 or MicroVAX (VMS).
Language: FORTRAN, approximately 12,000 lines of code.
Documentation: Programming Manual, Users Manual and Training Guide.

SECURITY CLASSIFICATION: Model without data base is unclassified; data bases are usually classified.

GENERAL DATA:

Data Base: Preprocessors allow rapid entry and review of data base entities. Data acquisition time involved in construction of completely new scenario can be lengthy.

CPU time per Cycle: Six-hour attack cycle run in less than 5 minutes clock time.

Data Output Analysis: Simulation results are tabulated. Output processing depends on the analysis being conducted. Results must be manually transferred for graphing.

Frequency of Use: Varies by user.

Users: USAMSIC, USAMICOM (ATM PO), USASDC, USASDC/SDIO, SDIO/Israel, SDIO/MITSUBISHI, JTMDPO.

TITLE: DIVLEV - AMSAA Division Level Wargame.

DATE IMPLEMENTED: 1971.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Materiel Systems Activity (AMSAA), Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: Tony Rouse, (301) 278-5771, DSN 298-5771.

PURPOSE: DIVLEV is used primarily to evaluate the impact of system-level items in the context of division and corps levels. It has also been used to evaluate different weapon mixes and tactics.

DESCRIPTION:
Domain: Ground combat (including ground-air and air-ground).

Span: Accommodates most theaters, depending on data base. Developed primarily for Central Europe but has been modified for Middle East and Southwest Asia.

Environment: Statistical terrain is overlaid by 250-meter vegetation and urbanization grid. Weather, day/night, and natural and man-made obstacles are included.

Force Composition: Combined forces, RED and BLUE.

Scope of Conflict: Primarily conventional warfare with limited chemical effects. Virtually all conventional weapon systems are included.

Mission Area: All conventional combined arms ground and helicopter combat. Tactical aircraft are included with the exception of air-to-air combat.

Level of Detail of Processes and Entities: Unit size can vary, but for most applications BLUE forces are played at company level and RED forces at battalion level. All artillery units are played at battery level. Direct-fire attrition is based on Lanchester coefficients on an element-to-element level. Indirect-fire attrition is based on target density and lethal effects of the incoming munitions.

CONSTRUCTION:
Human Participation: Required for decisions during wargaming phase. Once a set of decisions has been developed, the model can be used as a simulation without player intervention.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Completely deterministic.

Sidedness: Two-sided, asymmetric. Both sides are free to react to the tactical situation.

LIMITATIONS: Does not play air-to-air combat or nuclear warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expected modifications include the use of SUN graphics to east the burden of tactical input and to improve output display.

INPUT: Input includes force composition, player-developed conditional orders, direct-fire weapon-target kill rates, indirect-fire lethal areas, and terrain data.

OUTPUT: Printouts of unit positions, strengths and remaining orders, and killer/victim scoreboards.

HARDWARE AND SOFTWARE:
- Computer: SUN 4/280 (UNIX).
- Storage: 125K words.
- Peripherals: Disk storage.
- Language: FORTRAN V/FORTRAN 77.
- Documentation: Available from point of contact.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Acquisition - 3 man-months.
Preparation - 1 man-month.
Setup time - 5 to 6 hours player training.
Playing time - 1:8 game time to real time while wargaming.

CPU time per Cycle: 5:1 game time to computer time.

Data Output Analysis: Concurrent with game play.

Frequency of use: 1 to 2 games played per year (50 to 100 runs per year).

Users: U.S. Army Materiel Systems Analysis Activity.

Comments: N/A.

TITLE: DNYPSIM - Wind/Pasquill Stability Simulator.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: United States Air Force Environmental Technical Applications Center (USAFETAC), Environmental Simulation Section. USAFETAC/DNY, Scott AFB, IL 62225-5438.

POINT OF CONTACT: Capt Anthony J. Warren, DSN 576-5412, Commercial (618) 256-5412.

PURPOSE: DNYPSIM is a weather simulator. Specifically DNYPSIM provides input to a larger scale simulation model that determines three-dimensional diffusion patterns for biochemical applications. It produces simulated observations of wind direction, wind speed, and Pasquill stability for selected sites at specified time increments.

DESCRIPTION:

Domain: The model simulates lower troposphere weather conditions.

Span: Global. Currently the data base consists of 55 worldwide locations.

Environment: Serves as an environment sub-model to larger scale simulation models.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Models provide data for any combination of stations in data set. Geographical, diurnal, and seasonal tendencies are built into climatological data set.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: Dynamic, time-stepped model. Model uses a fixed time-step.

Treatment of Randomness: Stochastic, Monte Carlo. The four-dimensional Boehm Sawtooth Wave model is used to generate fields of spatial and temporally correlated random numbers.

Sidedness: One-sided.

LIMITATIONS: Currently only 55 dates are contained in data set.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Mean "u" and "v" wind component, standard deviation, cross correlation, mean cloud-cover cloud, and scale distances for wind and cloud-cover. The scale distance is a modeling parameter and is a measure of the variability from the mean. The input data base can be obtained from USAFETAC.

OUTPUT: Wind duration, speed, and Pasquill stability are produce for the desired stations, date, time, and time-step. Observations are accumulated in an output file designated by the user.

HARDWARE AND SOFTWARE:

Computer(OS): Designed on an IBM mainframe using the MVS operating system, but written in ANSI-Standard FORTRAN specifically to enhance portability to other computers and operating systems.

Storage: 77 Kilobytes.

Peripherals: None required.

Language: ANSI-Standard FORTRAN 77.

Documentation: USAFETAC/PR-88/001, Wind/Pasquill Stability Simulation Model.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Model coefficients are prepared by USAFETAC. Processing time is minimal.

CPU time per Cycle: Dependent upon the number of locations and the desired time-step. Output for one station and one time-step requires 0.14 seconds of CPU.

Data Output Analysis: Output file contains chronological list of stations and observations. No further processing is required.

Frequency of Use: Model has had limited use since its inception.

Users: Air Force Aerospace Medical Research Laboratory (AFAMRL).

Comments: None.

TITLE: DUELS 3.0.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis (Interactive version suitable for training).

PROPONENT: Technical Solutions, Inc.

POINT OF CONTACT: Mr. George Ober (Major, USA, Ret.) (505) 524-2154.

PURPOSE: A high resolution stochastic simulation of combat for small force on force studies (BN and below), material interaction exerciser and interactive training and training effectiveness analysis. Represents up to 200 systems with sensors and weapons on DMA terrain to provide for evaluation of systems effectiveness in mixed DUELS.

DESCRIPTION:

Domain: Land and air (CAS).

Span: Local, up to BN sector of responsibility.

Environment: Uses DMA terrain and features. Uses NVEOL to model sensors, EOSAEL to model atmospheric and obscuration.

Force Composition: Up to 200 systems of varying types organized into Red and Blue forces with two weapons and two sensors per system. Incorporate JEM for air engagement.

Scope of Conflict: Conventional, robotic systems and intelligent mines.

Mission Area: All conventional ground combat.

Level of Detail of Processes and Entities: Lowest level entity modeled in the system (including individual mines). Typical scenarios include ground systems and close air support. Processes modeled include movement on DMA terrain (with optional switch for high resolution terrain for mobility issues), detection and engagement, lethality and vulnerability (AMSAA-compatible data base format), accuracy of weapons, target prioritization, sensor performance, battlefield obscurant and mines. Allows interactive use for control of a single system. Integrated with a Battle Graphics System (BGS) and Battle Analysis System (BAS) for automated scenario development, playback and analysis.

CONSTRUCTION:

Human Participation: Allowed, but not required. When used, model continues while decision is being made.

Time Processing: Dynamic, event sequenced.

Treatment of Randomness: Stochastic, Monte Carlo sequenced.

Sidedness: Two-sided, symmetrical.

LIMITATIONS: Six system types per side, 200 system total, two weapons and two sensors per system.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of a controller function for simulation-time scenario modification.

INPUT: Accepts weapon system data, weapon accuracy data, including bias and dispersions, probability of hit and probability of kill by 30 degree aspect angle, DMA terrain, micro-terrain (if defined), planned movements, target priorities and sensor data.

OUTPUT: Provides an event history report and standard outputs of mean kills, mean and total ammunition expanded, exchange ratios, confidence level statistics, K/N scoreboard and interfaces to BGS for automated postprocessing and playback. Additional switch selectable output available on demand.

HARDWARE AND SOFTWARE:

Computer:	Will run on most computers including UNIX-based and VAX computers.
Storage:	Requires about 500 kb of disk storage for model.
Peripherals:	Printer, VDT, Disk.
Language:	FORTRAN 77 and C.
Documentation:	Programmers and Users Manuals.

SECURITY CLASSIFICATION: Unclassified, but may use classified data.

GENERAL DATA:

Data Base: Most data bases are usable as received from proponent agencies. Set up a new scenario using BGS and scenario development tools can be accomplished in less than one week.

CPU time per Cycle: About 5 minutes for a 15-minute battle slice without obscurant, or 15 minutes with obscurant, for 50 systems on a VAX 11/780.

Data Output Analysis: Some summary data available from output. Extensive analysis capability through interface to BGS and BAS.

Frequency of Use: Daily, at several customer sites.

Users: Royal ordinance, Alliant Techsystems, USA ARDEC, TSI.

Comments: Maintenance contracts available for continuing support. Source code may be licensed. Software is being continually upgraded and is under configuration control.

TITLE: Dunn Kempf.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Training and education.

PROPONENT: Office of the Training Simulations System Manager (TSSM), The Combined Arms Training Activity (CATA), Ft. Leavenworth, KS 66027-7000.

POINT OF CONTACT: CPT John Hughes or SFC Albert J. Malveaux, AV 552-3395/3189.

PURPOSE: Dunn Kempf is designed to train company-level leaders in planning and conducting small unit tactics.

DESCRIPTION:
Domain: Land and air.

Span: A Central European setting.

Environment: Three-dimensional European terrain in the kit. Weather and time of day are put out in the operations order.

Force Composition: Joint and combined forces, BLUE and RED Army.

Scope of Conflict: Conventional war game.

Mission Area: All conventional missions. Cannot be used for unconventional missions.

Level of Detail of Processes and Entities: The lowest level entities are platoon-size units.

CONSTRUCTION:
Human Participation: Required; 5 to 17 players and 1 to 3 controllers needed.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Dunn Kempf does not display units in wooded areas. In addition, model has no naval module.

PLANNED IMPROVEMENTS AND MODIFICATIONS: There will be no improvements or modifications.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:
Computer: None.
Storage: Only storage requirement is the need for a room to store your Dunn Kempf kit.
Peripherals: Three-dimensional boards, miniature tank, APC for both the BLUE and the RED armies, and maps.
Language: N/A.
Documentation: Very well documented with quite a number of supplements.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: None.

CPU time per Cycle: None.

Data Output Analysis: None.

Frequency of Use: Not used much anymore; it has mostly been replaced by FB:B-C.

Users: The Infantry School, Armor School, and Officer Basic Course.

Comments: N/A.

TITLE: DWG - Divisional War Game.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis (but has some training value in relation to the use of future systems).

PROPONENT: Defense Research Agency/Military Division, Fort Halstead, Sevenoaks, Kent, England TN14 7BP.

POINT OF CONTACT: The Superintendent, Indirect Fire System Studies Division, RARDE (UK) 0959 32222 X3005.

PURPOSE: The DWG is a research and evaluation tool used to examine the effectiveness of weapon system and tactical concepts at the brigade and division levels. It contributes to a wide range of assessment studies through the provision of performance and scenario data.

DESCRIPTION:

Domain: Land and air battle in the Central Region.

Span: Division/Corps.

Environment: Terrain is modeled as 500m-quadrants with cover and going types. Roads and rivers are represented, and intervisibility is based on matrices for fixed heights. Meteorological conditions vary with time of day (both day and night are gamed).

Force Composition: Combined forces based on individual components and unit types (RED and BLUE).

Scope of Conflict: Conventional only (RED and BLUE).

Mission Area: All aspects of land and air battle.

Level of Detail of Processes and Entities: Varies between and within sides. Tanks are modeled as companies (RED) or combat teams (BLUE): rocket artillery is modeled as single vehicles (BLUE) or batteries (RED). Similarly, tube artillery (guns and mortars), helicopters, fixed wing aircraft, air defense, and engineering systems. Submodels assess the effect of interactions and attrition, and sightings are calculated explicitly at the unit level. Players issue orders to individual units. Communication nets are also modeled, and delays are calculated explicitly. The temporal resolution is six seconds.

CONSTRUCTION:

Human Participation: Required for decisions. In the absence of a decision, units run out of orders and suffer accordingly.

Time Processing: Dynamic, event-step (with a six-second time grain).

Treatment of Randomness: Direct fire attrition is based on Lanchester. Other models are stochastic with computation of kill/detection probabilities and Monte Carlo determination of outcome.

Sidedness: Two-sided, symmetric with approximately 20 players.

LIMITATIONS: None other than those appropriate to resolution employed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Continuous program of model review particularly related to the systems of greatest interest in each series.

INPUT: Terrain data, unit characteristics (weapons, speeds, activities, deployments, etc.), attrition data, and scenario-specific data (deployments, nets, orders).

OUTPUT: Relational data base of unit life histories. Event/occurrence diaries and system-specific trace files (e.g., BLUE/RED artillery).

HARDWARE AND SOFTWARE:

Computer:	Digital VAX running VMS.
Storage:	Game: 64MB; Disk/Type: approximately 2Gb.
Peripherals:	Variable but numerous (5 x Sigmex Graphics, 2 x microVAXII, approximately 40 x VT220, approximately 20 x printer).
Language:	VAX FORTRAN.
Documentation:	Out of date except for Function Specification.

SECURITY CLASSIFICATION: Secret (model and data not separate).

GENERAL DATA:

Data Base: From scratch requires 5-10 man-years; series setup requires 3 man-years including map boards.

CPU time per Cycle: Each 6 seconds of game time takes 60-180 seconds real time with a dedicated VAX 785.

Data Output Analysis: Interrogation of data base in response to specific requests.

Frequency of Use: Five to six one-month games per year.

Users: UK MOD (but others are possible with mutual agreement).

Comments: N/A.

TITLE: EADSIM - Extended Air Defense Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Joint Theater Missile Defense Program Office (JTMDPO), United States Army Strategic Defense Command (USASDC), P.O. Box 1500, Huntsville, AL 35807-3801.

POINT OF CONTACT: Mr. Raymond Washburn, AV 645-1562, Com (205) 955-1562.

PURPOSE: EADSIM is used primarily to analyze theater-level Extended Air Defense scenarios. It is specifically designed to evaluate effectiveness and efficiency of weapons systems against targets and to evaluate the value of different mixes of forces or resources.

DESCRIPTION:
Domain: Land and air; involvement in naval operations is increasing.

Span: Accommodates any theater, depending on terrain data base; several theater data bases currently available (Central Europe, Southwest Asia, Southeast Asia, Japan, selected sectors of the United States); others in preparation.

Environment: Polygon based. Models day operations only. No current provisions for modeling night operations or degrees of weather. Roads, rivers and other terrain cultural features (Digital Features Analysis Data) are not modeled, but these data are available from the Defense Mapping Agency and are usually available with the Digital Terrain Elevation Data.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Limited to conventional warfare. Virtually all conventional weapons and their effects can be modeled.

Mission Area: All conventional missions except unconventional warfare.

Level of Detail of Processes and Entities: Same resolution for both Red and Blue ground and air elements. Lowest level unit modeled on the ground is the fire unit (e.g., HAWK Assault Fire Unit, PATRIOT Fire Unit, etc.). Lowest level unit modeled in the air is the aircraft (e.g., F-15, F-15, MIG-29, etc.), or missile (e.g., cruise missile, SA-21, etc.). Attritions for both ground and air are given down to single entities. Communications modeled down to the data link level. Models the movement of aircraft and missiles; aircraft according to pre-planned flight paths; missiles according to appropriate trajectories, but both Red and Blue are reactive in accordance with the rulesets, once engaged in combat.

CONSTRUCTION:
Human Participation: Not required for decisions or processes. However, a version of the model does allow for limited Man-in-the-Loop operations.

Time Processing: Dynamic, time- and event-stepped model. Progresses through events at a specified interval of time. Ratio of exercise time to real time varies depending upon the size of scenarios.

Treatment of Randomness: Land and air attrition based on direct computation of probability of detection and probability of kill, with Monte Carlo determination of the results.

Sidedness: Two-sided, symmetric, both sides reactive model. Can be operated by one (1) operator.

LIMITATIONS: Does not currently model all Naval air operations; low fidelity of EO/IR modeling.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Naval inputs to the model being developed.

INPUT: Scenarios developed based upon building block technique. Operator/analyst initially develops elements such as aircraft, sensors, jammers, weapons, and icons by filling in parametric values in data tables. These elements are combined with rulesets and communications devices to form systems, such as an F-15. The systems, with appropriate protocols added, are deployed on the digitized terrain map as platforms. Appropriate networks are added to the platforms by the analyst to form laydowns. The desired digitized map is selected, areas of interest are created, and selected laydowns are combined, to form scenarios.

OUTPUT: Produces movement and attrition of elements displayed on operator display. Playback files as well as data files are also produced. Printouts (pictures) of screen displays can also be produced.

HARDWARE AND SOFTWARE:

Computer(OS):	Designed to run on Silicon Graphics Super Workstations of the 4D series, with a UNIX operating system.
Storage:	760 MB hard disk and 24 MB Random Access Memory (RAM).
Peripherals:	Printer and color copier are optional.
Language:	C language.
Documentation:	Extensive documentation with five published manuals.

SECURITY CLASSIFICATION: Unclassified software, but data bases are often classified.

GENERAL DATA:

Data Base: Population of large data base can take several man-months.

CPU Time per Cycle: Dependent on data base size and scenario size. Large scenarios can take hours of CPU time to process hours of combat.

Data Output Analysis: Postprocessor aids in analysis of scenario output. Produces raw data files suitable for configuring by the analyst.

Frequency of Use: Varies by organization, but is used almost weekly by those listed below.

Users: The following organizations have the model and are currently using it:

- JTMDPO, USASDC, in the Advanced Research Center (ARC), Huntsville, Alabama

- United States Army Missile Command (USAMICOM), Redstone Arsenal, Alabama

- United States Army Air Defense Artillery School (USAADASCH), Fort Bliss, Texas

- Headquarters, United States Air Forces in Europe (HQ, USAFE), Ramstein Air Base, Germany

- SHAPE Technical Centre, The Hague, The Netherlands

- Defense Research Agency-Engineering Division (DRA-ED), Formerly Royal Signals and Radar Establishment (RSRE), Great Malvern, England

- 32nd Army Air Defense Command (32D AADCOM), Darmstadt, Germany

- U.S. Air Force Tactical Air Warfare Center (TAWC) Blue Flag, Eglin AFB, Florida

- Joint Air Defense Operations/Joint Engagement Zone (JADO/JEZ) Office, Eglin AFB, Florida

- Electronic Systems Division (ESD), Hanscom AFB, Massachusetts

- Air Force Center for Studies and Analysis (AFCSA), The Pentagon, Washington, DC

- Naval Air Systems Command (NAVAIR), Arlington, Virginia

- Phase One Engineering Team (RJO/POET), Arlington, Virginia

- Center for Naval Analysis (CNA), Arlington, Virginia

- Wales, Limited (Israeli Ministry of Defense Representative), Tel Aviv, Israel

- Air Force Foreign Technology Division (FTD), Wright-Patterson AFB, Ohio

- Strategic Air Command (SAC), Offutt AFB, Nebraska

- Joint Electronic Warfare Center (JEWC), Kelly AFB, Texas

Comments: The model is managed through a Configuration Control Board (CCB) made up of representatives of all users. The model has been upgraded based upon priorities established by the CCB and USASDC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: EADTB - Extended Air Defense Test Bed.

DATE IMPLEMENTED: 1992 (Projected).

MODEL TYPE: Analysis.

PROPONENT: Joint Theater Missile Defense Program Office (JTMDPO), United States Army Strategic Defense Command (USASDC), P.O. Box 1500, Huntsville, AL 35807-3801.

POINT OF CONTACT: LTC Alan R. Hammond, AVN 645-4954, Commercial (205) 955-4954.

PURPOSE: EADTB will be used primarily to analyze theater-level Extended Air Defense scenarios. It is being specifically designed to evaluate effectiveness and efficiency of weapons systems against targets and to evaluate the value of different mixes of forces or resources.

DESCRIPTION:

Domain: Land and air; minimal Naval involvement in the program to date.

Span: Accommodates any theater, depending on terrain data base; several theater data bases will be made available (Central Europe, Southwest Asia, Southeast Asia, Japan, selected sectors of the United States); others in preparation.

Environment: Polygon-based. Being developed to model day or night operations and various degrees of weather. Roads, rivers and other terrain cultural features (Digital Features Analysis Data) will be modeled, with data available from the Defense Mapping Agency, usually available with the Digital Terrain Elevation Data.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Limited to conventional warfare. Virtually all conventional weapons and their effects can be modeled.

Mission Area: All conventional missions except unconventional warfare.

Level of Detail of Processes and Entities: Same resolution for both Red and Blue ground and air elements is planned. Lowest level unit modeled on the ground will be the fire unit (e.g., HAWK Assault Fire Unit, PATRIOT Fire Unit, etc.). Lowest level unit modeled in the air will be the aircraft (e.g., F-15, F-16, MIG-29, etc.), or missile (e.g., cruise missile, SA-21, etc.). Attrition for both ground and air are given down to single entities. Communications will be modeled down to the data link level. Will model the movement of aircraft and missiles; aircraft according to pre-planned flight paths; missiles according to appropriate trajectories, but both Red and Blue will be reactive in accordance with the rulesets, once they are engaged in combat.

CONSTRUCTION:

Human Participation: Not required for decisions or processes. However, the model will allow for Man-in-the-Loop and Hardware-in-the-Loop operations.

Time Processing: Dynamic, time- and event-stepped model. Will progress through events at a specified interval of time. Ratio of exercise time to real time will vary depending upon the size of scenarios.

Treatment of Randomness: Land and air attrition will be based on direct computation of probability of detection and probability of kill, with Monte Carlo determination of the results.

Sidedness: Two-sided, symmetric, both sides reactive model. Can be operated by one (1) operator.

LIMITATIONS: No current plans to model all Naval operations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Naval inputs to the model being developed.

INPUT: Scenarios will be developed based upon building block technique. Operator/analyst initially develops elements such as aircraft, communications devices, sensors, jammers, and weapons by filling in parametric values in data tables. These elements will be aggregated into systems, such as an F-15. The systems will be deployed on the digitized terrain map as platforms. The platforms will be combined into laydowns which will then be combined to form scenarios.

OUTPUT: Will produce movement and attrition of elements displayed on operator display. Playback files as well as data files will also produced. Printouts of screen graphics displays can also be produced. Postprocessor will assist in data analysis efforts.

HARDWARE AND SOFTWARE:

Computer (OS):	Being designed to run on a mainframe computer, as yet to be selected, and Silicon Graphics Super Workstations of the 4D series, with a UNIX operating system.
Storage:	9GB hard disk and 450MB Random Access Memory (RAM).
Peripherals:	Several optional items, including printer, color copier, and video and audio recording devices.
Language:	Ada.
Documentation:	Extensive documentation will be published.

SECURITY CLASSIFICATION: Unclassified software is planned; data bases will be classified.

GENERAL DATA:

Data Base: Population of large data base can take several man-months.

CPU Time per Cycle: Dependent on data base size and scenario size. Large scenarios will probably take hours of CPU time to process hours of combat.

Data Output Analysis: Postprocessor will aid in analysis of scenario output. Will produce raw data files suitable for configuring by the analyst.

Frequency of Use: Will vary by organization, but should be used almost weekly by those listed below.

Users: The following organizations will have the model following delivery to government:

- JTMDPO, USASDC, in the Advanced Research Center (ARC), Huntsville, Alabama

- United States Army Air Defense Artillery School (USAADASCH), Fort Bliss, Texas

The following organizations (candidate participants) may have the model following delivery to the government:

- Headquarters, United States Air Forces in Europe (HQ, USAFE), Ramstein Air Base, Germany

- SHAPE Technical Centre, The Hague, The Netherlands

- U.S. Air Force Tactical Air Warfare Center (TAWC) Blue Flag, Eglin AFB, Florida

- Joint Air Defense Operations/Joint Engagement Zone (JADO/JEZ) Office, Eglin AFB, Florida

- Electronic Systems Division (ESD), Hanscom AFB, Massachusetts

Comments: The model development is being managed through a Configuration Control Board (CCB) established by the development contractor. A CCB will be established by the government with representatives from all of the user organizations.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: Eagle - Corps/Division Analysis Model.

DATE IMPLEMENTED: N/A. Eagle is currently being developed. Estimated completion data is late 1991.

MODEL TYPE: Analysis and training.

PROPONENT: TRAC-FLVN, Fort Leavenworth, KS 66027-5200.

POINT OF CONTACT: Mr. Kent Pickett, (913) 684-4016.

PURPOSE: This effort will develop a fast-running systemic simulation for use by combat development studies involving new doctrine, scenario development, and future concept analysis. Eagle is designed for corps/division-level of analysis using object-oriented design, artificial intelligence, and state-of-the art software development tools. It will also serve the training community as a seminar exercise driver training tool.

DESCRIPTION:

Domain: Land and air.

Span: Any theater depending on data base.

Environment: Network terrain using 100-meter data points.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional and nuclear, BLUE and RED.

Mission Area: All U.S. Army conventional missions.

Level of Detail of Processes and Entities: Entities: maneuver battalions, artillery batteries, ADA batteries, air flights, and command post units. Processes: movement, direct and indirect fire attrition, air defense attrition, C2, and detection.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step with air event stop overlays.

Treatment of Randomness: Land and air attrition deterministically based on Lanchester coefficients.

Sidedness: Two-sided, symmetric, reactive. Can be tested by a single operator or operated by two or more operators.

LIMITATIONS: Model development has just begun. Various stages will commence with functional areas added as time permits.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A. The command and control concept has just begun as the first step in developing the functional areas aspect of the model.

INPUT: 100-meter terrain points, weapons, movement, and unit characteristics.

OUTPUT: Produces graphic output of location by unit, status reports, etc.

HARDWARE AND SOFTWARE:

Computer: Designed to run on a Symbolics or SUN with SUN Graphics.
Storage: Undetermined.
Peripherals: SUN Graphics only.
Language: LISP and KEE.
Documentation: N/A.

SECURITY CLASSIFICATION: Unclassified, but data bases will be secret.

GENERAL DATA:

Data Base: Months required to prepare input data.

CPU time per Cycle: Undetermined; prototype being developed.

Data Output Analysis: Postprocessor being developed.

Frequency of Use: Not yet being used.

Users: N/A.

Comments: N/A.

TITLE: EASY - Environmental Analysis System.

DATE IMPLEMENTED: UNISYS version: 1980; IBM PC version: 1991.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center (ECAC), North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: EASY is a research and evaluation tool used for determining system effectiveness and resource planning in the area of electromagnetic spectrum use. It provides data to analyze and predict potential intersite electromagnetic interference between an existing C-E equipment environment, and new C-E equipment being introduced into that environment. The equipment environment may be created from frequency assignment records, equipment characteristics records, or tactical data records stored in the ECAC data base and/or from user supplied records. The program allows the user to create, maintain, and analyze project files. The user may select one of four analysis types to be performed: interference power, power density, interference-to-noise, and signal-to-interference.

DESCRIPTION:

Domain: Land, sea, air or a combination of any of the above environments.

Span: Regional.

Environment: Terrain effects are considered given Defense Mapping Agency (DMA) Level 1 Digital Terrain Elevation Data (DTED) for a region of interest. Ground constants, atmospheric parameters, and ambient noise are also considered.

Force Composition: Combination of forces. (The model is force independent.)

Scope of Conflict: Primarily conventional warfare. Non-electromagnetic combat effects and nuclear detonation effects not considered.

Mission Area: Communications and communications jamming missions.

Level of Detail of Processes and Entities: Electromagnetic interference parameters (specifically interference power, power density, interference-to-noise ratio, and signal-to-interference ratio) are calculated based on specific geographic location information (such as latitude and longitude, fixed/mobile indicator, radius of mobility, antenna height and antenna azimuth) and C-E system characteristics (such as operational frequency, emission, selectivity, and antenna gain).

CONSTRUCTION:

Human Participation: Required to define existing environment and newly introduced system records, and to select analysis processes.

Time Processing: Static.

Treatment of Randomness: The user selects from a suite of deterministic (expected value) and stochastic (direct computation) processes.

Sidedness: One-sided.

LIMITATIONS: Analysis is performed for systems operating with frequencies between 30 MHz and 20 GHz. The tool is not effective for analysis between collocated equipment, as the analysis does not consider nonlinear electromagnetic effects or antenna near field gain corrections. Operational duty factors are also not considered.

INPUT: EASY data file maintenance modules requires C-E system locations and operating characteristics. Analysis modules access EASY data files and topographic data files, and require analysis directives.

OUTPUT: Printouts and displays of data and results in tabular and graphic plot form.

HARDWARE AND SOFTWARE:

Computer:	EASY runs on the Unisys 1100/Sharing EXEC-multi-processor system level 39R8-OP-104. A limited version runs on the IBM-compatible PC under the MS-DOS operating system.
Storage:	Unisys program: 2.3 MegaWords; IBM PC version: 300KB (additional 700KB required for FoxPro). Additional storage requirements depend on the number of environmental and introduced records.
Peripherals:	One printer, one terminal (for the Unisys version), one TEKTRONIX (optional for graphic plots for the Unisys version), and one CALCOMP plotter (optional for graphic plots for the Unisys version).
Language:	FORTRAN and FOXPRO (for the IBM PC version).
Documentation:	Documentation is based on the Unisys version, an addendum exists for the IBM PC version.

SECURITY CLASSIFICATION: Unclassified program, data and results may be classified to the secret level.

GENERAL DATA:

Data Base: Preparation of data base can take several man-days to several weeks.

CPU time per Cycle: Depends on data base size. Averages about 500 interactions (a single interfering transmitter against a victim receiver) per minute.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: 3,000 runs per year.

Users: ECAC.

Comments: Originally developed by ECAC for general environmental analysis projects support.

TITLE: ECECE - Electronic Combat Equipment Capabilities Evaluation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: AFEWC/SATR, San Antonio, Texas 78243.

POINT OF CONTACT: Mr. Rick Salinas, DSN 969-2391, (512) 977-2391.

PURPOSE: Analysis: Used to determine one jammer's effectiveness against one radar system. Effectiveness is then presented graphically and as a single number.

DESCRIPTION:
Domain: Land and air.

Span: Local.

Environment: Smooth earth.

Force Composition: One jammer versus one radar.

Scope of Conflict: None.

Mission Area: None.

Level of Detail of Processes and Entities: Entity: Determines one jammer's effectiveness against one radar system. Effectiveness is then presented graphically and also as a single number. Processes: The radar and jammer range equations are used to compute a jammer to signal (J/S) ratio for a constant heading target in one kilometer cells all around the radar. If this J/S exceeds the required J/S for the specified jamming technique, then the cell is considered jammed. This allows J/S maps to be created and overlaid for different jamming techniques or radar system effects. Sums and ratios between jammed and unjammed cells can be computed to generate single numbers.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic event-step model.

Treatment of Randomness: Deterministic calculations.

Sidedness: One-sided.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

HARDWARE AND SOFTWARE:
Computer (OS): MicroVax II.
Storage: Four megabytes are required for executable code and data bases.
Peripherals: Graphics terminal and printer.
Language: FORTRAN.
Documentation: None (user's notes only).

SECURITY CLASSIFICATION: The model without data is unclassified.

GENERAL DATA:
Data Base: 1 to 3 hours of preparation are required for each model.

CPU time per Cycle: 1 to 2 hours are required for an analysis cycle dependent on model complexity.

Data Output Analysis: Graphics aid in analysis of the printed output report.

Frequency of Use: Varies with tasking, but 8-12 weeks per are normal.

Comments: Model uses non-standard software.

TI"LE: EDECSIM - Extended Directed Energy Combat Simulation.

DATE IMPLEMENTED: 198).

MODEL TYPE: Analysis.

PROPONENT: CA4 Division, RARDE Fort Halstead, Sevenoaks, England.

POINT OF CONTACT: Mr. D.F. Wardleworth, tel. 0959 32222, ext 3388.

PURPOSE: Study of effectiveness of conventional and novel DF weapons and smart munitions.

DESCRIPTION:
Domain: Land; representation of rotary wing aircraft and low level air defence under development.

Span: There is no hard upper limit terrain size nor on numbers of units represented. Several hundred units on an area 20km square have been studied.

Environment: Terrain height and vegetation/building cover are modeled to a horizon resolution of 100m. Obscuration, poor visibility and TI sensors can be represented but pyrotechnic illumination and other night viewing enhancements are not currently modeled.

Force Composition: EDECSIM is two-sided and represents the essential characteristics of vehicle borne and certain dismounted weapons. Infantry and fixed wing aircraft are not represented.

Scope of Conflict: Conventional weapons; other systems may be accommodated by program modification if suitable data is available.

Mission Area: Normal study parameters include attrition; assessment of assault success and enemy observation are also possible.

Level of Detail of Processes and Detail: Individual vehicles are represented and a variety of surveillance and engagement tactics can be selected. Vehicle routes are prespecified although a limited number of responses to battle development are possible. Smart munition missions are controlled by an autonomous module which deduces viable targets from observer reports; this module includes limited representation of communications. Obscuration, conventional artillery and minefields are represented implicitly.

CONSTRUCTION:
Human Participation: None, but scenarios are based on man-in-the-loop wargames.

Time Processing: Event-sequenced.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided, sides are interchangeable with no limits on size apart from overall constraints.

LIMITATIONS: Excessive divergence from the source wargame could lead to inappropriate responses. The other main limitation is run-time: large and intense battles demand appreciable computer resources.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Helicopters, fibre-optic guided missiles and low-level air defence are being implemented.

INPUT: Terrain data; unit detectability; weapon systems data including ranges, times of flight, rates of fire and lethality; deployments, routes and tactical responses including sensor usage rules; obscuration, minefield and artillery data.

OUTPUT: Overall attrition, inter-unit effectiveness by type, detections and engagements by time and range, individual unit interactions, area analysis by side and by status (live/dead); plots of unit positions. Graphics playback of individual replications allow interrogation of individual vehicles or ground-mounted GW units to determine status and activity at any time.

HARDWARE AND SOFTWARE: (for VAX; a Cray version is also available.)

Computer:	DEC VAX, 8700 or 785; GPX-II required for graphics.
Storage:	(Blocks) - for 29 minute scenario, input, 7000; output, 2000; graphics, 47000.
Peripherals:	A suitable terminal, printer and plotter.
Language:	Mainly VAX Pascal, some FORTRAN 77.
Documentation:	Functional Specification, Data Requirements Specification; User Guide in progress.

SECURITY CLASSIFICATION: Program UK Restricted.

GENERAL DATA:

Data Base: Scenario preparation time: transfer from RARDE CA4 Battlegroup Wargame (BGWG)-c. 4 man-weeks (scenario dependent).

CPU time per Cycle: Depends on scenario; a Main defensive Action with 154 units required 18 minutes CPU per minute of battle when run on a VAX 785; typically 10 replications are run per case.

Data Output Analysis: See OUTPUT.

Frequency of Use: 2-3 major and 2-3 minor studies per year.

Users: Combat Simulation Section, RARDE.

Comments: EDECSIM is constantly being developed and refined both to accommodate new concepts and to introduce more realism. A library of representative scenarios is being built up in order to permit suitable studies to be performed with minimal delay. Scenarios are normally derived from RARDE CA4 BGWG thus providing a high degree of military involvement in OA studies.

TITLE: EEDS - Emitter Environment Definition System.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center (ECAC), North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: EEDS is a research and evaluation tool used for determining system effectiveness and resource planning in the area of electromagnetic spectrum use. It provides data to analyze and define field strength or power density in a C-E equipment environment. Additionally, EEDS can be used to identify the strongest emission at each frequency over a range of frequencies, and to produce a plot of 'dominant' emission power as a function of frequency. The equipment environment may be created from frequency assignment records, equipment characteristics records, or tactical data records stored in the ECAC data base and/or from user supplied records. The EEDS program must be used in conjunction with ECAC's Environmental Analysis System (EASY) which creates, maintains, and analyzes project files of data required by EEDS.

DESCRIPTION:

Domain: Land, sea, air or a combination of any of the above environments.

Span: Regional.

Environment: None.

Force Composition: Combination of forces. (The model is force independent.)

Scope of Conflict: Primarily conventional warfare. Non-electromagnetic combat effects and nuclear detonation effects not considered.

Mission Area: Communications and communications jamming missions.

Level of Detail of Processes and Entities: Electromagnetic interference parameters (field strength, power density) are calculated based on specific geographic location information (such as latitude and longitude, fixed/mobile indicator, radius of mobility, antenna height and antenna azimuth) and C-E emitter characteristics (such as operational frequency, emission, and antenna gain).

CONSTRUCTION:

Human Participation: Required to define existing environment and newly introduced system records using the EASY programs and to select analysis processes.

Time Processing: Static.

Treatment of Randomness: Deterministic (expected value).

Sidedness: One-sided.

LIMITATIONS: Analysis is performed for systems operating with frequencies between 30 MHz and 20 GHz. Operational duty factors are also not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Parts of EEDS have been implemented on an IBM-compatible PC in support of various projects. In response to a general demand, a full version of EEDS is being planned for the PC.

INPUT: EASY (EEDS operates on EASY files and therefore uses EASY capabilities) data file maintenance modules require C-E system locations and operating characteristics. EEDS analysis modules access EASY data files and require analysis directives.

OUTPUT: Printouts and displays of data and results in tabular and graphic plot form.

HARDWARE AND SOFTWARE:

Computer:	EEDS runs on the Unisys 1100/Sharing EXEC-multi-processor system level 39R8-OP-104.
Storage:	EEDS program: .9 MegaWords. Additional storage requirements depend on the number of environmental records.
Peripherals:	One printer, one terminal, and one TEKTRONIX (optional for graphic plots), and one CALCOMP plotter (optional for graphic plots).
Language:	FORTRAN.
Documentation:	Documentation (ECAC-UM-91-064) is in the final stage of publication.

SECURITY CLASSIFICATION: Unclassified program, but data and results may be classified.

GENERAL DATA:

Data Base: Population of large data base can take several man-days.

CPU time per Cycle: Depends on data base size. Generally requires several minutes of CPU time.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Approximately 200 runs per year.

Users: ECAC.

Comments: Originally developed by ECAC for general environmental analysis projects support. Must be used in conjunction with EASY.

TITLE: E-EFAM - Expanded Engineer Functional Area Model.

DATE IMPLEMENTED: Under development.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-EN-A, P.O. Box 631, Vicksburg, MS 39181-0631.

POINT OF CONTACT: Phillip L. Doiron, (601) 634-3855.

PURPOSE: E-EFAM is being developed as a series of high-detail engineering task models. These models will predict the performance of engineering equipment on mobility, countermobility, survivability, and general engineering tasks. The output of these models will be used in the development of scenario data for war games as well as for analysis of engineering equipment and functions.

DESCRIPTION:
Domain: Land.

Span: Based on 1:50,000 scale map quadrangle.

Environment: Grid-based. Each 100m grid cell contains the terrain and environmental descriptions of the area. These terrain descriptions can include the topographic elevation; vegetation type, height, and density; soil type and moisture content; water depth, width, and velocity; urban structure height and density; and road type and width. The environmental descriptions can include type and amount of precipitation and the snow depth.

Force Composition: Engineering forces, both BLUE and RED.

Scope of Conflict: Conventional and unconventional.

Mission Area: Military engineer operations.

Level of Detail of Processes and Entities: The performance of each engineering task is simulated. The simulation is geared primarily toward analyzing the interaction of the engineering equipment with the terrain and environmental conditions occurring the selected minefield. The engineering tasks can be located anywhere on a 1:50,000 scale map quadrangle and can be of any size and configuration.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Inability to simulate full RED engineer tasks.

PLANNED IMPROVEMENTS AND MODIFICATIONS: In the near future, foreign engineer mine systems will be included in the model.

INPUT: Relevant terrain and environmental factors and engineering system characteristics.

OUTPUT: Produces graphical display and tabular printouts of engineering system performance.

HARDWARE AND SOFTWARE:

Computer: Designed to run on a MicroVAX computer with VMS operating system.

Storage: 13 MB required to run the model.

Peripherals: Minimum requirements: 1 printer, 1 Raster 380 graphics terminal, 1 VT100 terminal.

Language: FORTRAN.

Documentation: Conceptual design document (in preparation).

SECURITY CLASSIFICATION: Model is unclassified, but some data and model outputs are classified.

GENERAL DATA:

Data Base: 3 months to prepare digital terrain data base.

CPU time per Cycle: N/A.

Data Output Analysis: Manual.

Frequency of Use: Used when required to research and development efforts.

Users: U.S. Army Engineer Waterways Experiment Station.

Comments: Model is presently being developed with a completion date in FY95.

TITLE: EIEM - Electromagnetic Interference Effects Model.

DATE IMPLEMENTED: 1970.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds, ATTN: [STEEP-(T-E)], Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: The EIEM is an operational support tool that is used to assist in conducting compatibility and vulnerability analysis of communications and electronic equipment and systems in tactical deployments. The output is used to determine if systems are suitable for deployment.

DESCRIPTION:

Domain: Land and air. Limited space and naval.

Span: Accommodates any theater depending on data base. Can model individual equipment to full corps and above deployments.

Environment: Detailed RF phenomonology model. Models the effect of terrain and ground constraints in either area prediction or point-to-point mode. Options available to use Defense Mapping Agency digitized terrain data as input. Effects of time of day, month, and climatology are considered for various propagation models.

Force Composition: Joint and combined forces, BLUE, GREY, and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: EIEM uses deployment data concerning the location, terrain, and required linking of communications-electronics equipment contained in a tactical force to calculate the communicability, compatibility, and vulnerability of communications-electronic systems. EIEM samples a required number of links and initially determines the probability of communication (compatibility) over a link without interference based upon equipment technical performance characteristics and propagation losses. The model then computes the propagation loss for each possible interferer and computes a desired versus interferer signal ratio. The model then computes the probability of correct information transfer (compatibility), using previously measured performance data (scoring) for each communications-electronics equipment. The effects of jamming (vulnerability) on each link are similarly calculated by substituting the jammer as the interferer. ESM functions of intercept and DF are also modeled. For DF, the model can produce both a numerical probability of DF and an associated CEP value.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Statistical.

Treatment of Randomness: Can be run in either deterministic or probabilistic mode. Monte Carlo options are available for estimations of propagation variables from the mean.

Sidedness: Not applicable.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Propagation modules are under study for enhancement plus computer graphical development for file updates, data checks, and model output presentations.

INPUT: Tactical deployment data, equipment technical performance characteristics, propagation path loss parameters, and message traffic data.

OUTPUT: Printout of probability of communications-electronics equipment/systems communicability, compatibility, and vulnerability performance in their intended tactical operational environment.

HARDWARE AND SOFTWARE:

Computer:	CYBER 180 Model 830.
Storage:	Variable. Requirements can be adjusted.
Peripherals:	Optimum number of disk and tape drives varies; variable mass storage requirements in size of data files determine requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented with four manuals published.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires 1 year. Analysis requiring data modification for specific test system requires 1 to 2 months depending on system.

CPU time per Cycle: Dependent on deployment size and number of equipment to be evaluated. Corps-size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts.

Frequency of Use: Varies, 4 to 6 analyses performed per year.

Users: Model is resident at USAEPG. Numerous analyses have been performed for a variety of government agencies.

Comments: The model is not machine independent. However, the model takes advantage of the CDC CYBER 60-bit word for optimizations of data storage and access and would require modification for other environments.

TITLE: The Electronic Workbench 11.

DATE IMPLEMENTED: Prototype developed in 1987. Revised in 1989 and 1990.

MODEL TYPE: The model has aspects of both analysis and training/education. It does not fit neatly into either category.

PROPONENT: Joint Staff, J6.

POINT OF CONTACT: Dr. John Dockery, Joint Staff, J6E, The Pentagon, Washington, DC 20318-6000; Also: Dr. A.E.R. Woodcock, Chief Scientist, Synectics Corp, 10400 Eaton Place, Fairfax, VA 22030.

PURPOSE: Explore the use of cellular automata mathematics as a basis for combat modeling; and to compare the results with Lanchester based models within the same common software framework. It is intended to build command and control (C2) directly into a model of combat. With this is mind it is possible to state that when used for: (a) Analysis, it is primarily a research and evaluation tool directed at exploring new ways of modelling unit interaction by obtaining maximum combat structure from a minimum of rules and unit interactions; and that when used for: (b) Training and Education, it is directed at sharpening the gamer's insights into the role of C2 in combat and to provide new avenues for building higher level models.

DESCRIPTION: This model has features not captured by the standard categories under this heading. It works as follows: Combat may be conducted for small unit configurations either under the control of stochastic Lanchester Equations, or under the control of cellular automata rules. The stochastic treatment of Lanchester modelling means that a family of outcomes is generated and displayed on the screen according to certain termination of conflict rules based in turn on absolute, proportional or catastrophe theory based logic. These may be compared with results from a cellular automata, which is the mathematical study of cells whose future is totally determined by the actions of neighboring cells. Using point and click (or a special input language) two deployments are constructed and engage according to parameters set by the user. The action may be interrupted and parameters reset without restarting. A considerable number of classical encounters (pre-modern) have been successfully simulated giving insight into the role of doctrine and training as a base for C2.

CONSTRUCTION:
Human Participation: The workbench can be used with or without intervention.

Time Processing: Based on the periodic update of the entire automata.

Treatment of Randomness: Basically stochastic.

Sidedness: Two-sided and asymmetric with both sides reactive.

LIMITATIONS: These are set by the prototype nature of the "game board" which is a subset of the Macintosh screen although an offshoot developed in Sweden has eliminated this difficulty using a SUN workstation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The workbench is a prototype and is under examination by laboratories in the U.S. and abroad.

INPUT: Point and click deployment plus direct screen input of a dozen or so parameters.

OUTPUT: Screen display of results.

HARDWARE AND SOFTWARE:

Computer: Early versions on VAX and DOS based machines. Currently configured for Macintosh IIx. It has been ported to the SUN machines.

Storage: N/A.

Peripherals: N/A.

Language: PASCAL.

Documentation: A user's guide and final report exist. It may be used with the aid of a "README" file.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: A few minutes on a Macintosh IIx.

Users: J6 and various C2 laboratories

TITLE: EMC^2 - E&S Corp. Model of Close Combat.

DATE IMPLEMENTED: 1984 (Updates through 1991).

MODEL TYPE: Analysis.

PROPONENT: Electronics and Space Corp. (E&S Corp.), 8100 W. Florissant, St. Louis, MO 63136.

POINT OF CONTACT: Gus Zenker, 314-553-4635, (FAX) 314-553-4750.

PURPOSE: EMC^2 is a research and evaluation tool used to analyze ground and helicopter combat system performance and operational effectiveness in realistic, close combat, battlefield environments. Its very high resolution allows investigation and comparison of subsystems to include electromagnetic and acoustic spectral sensors; fire control, weapons and munitions; system survivability and mobility.

DESCRIPTION:
Domain: Land, air.

Span: Local up to brigade-sized area of operation.

Environment: Digitized terrain; weather effects played implicitly through sensor and mobility performance; dynamic generation of smoke and dust and acoustic backgrounds due to combat activities.

Force Composition: Combined arms elements from task force to individual soldier level with normally associated ground based and aerial fire support, Red and Blue.

Scope of Conflict: Conventional, close combat with associated fire support.

Mission Area: Heavy and light close combat, fire support, attack helicopter operations.

Level of Detail of Processes and Entities: Very high resolution, explicit simulation of system/subsystem operations. A "system" may have different numbers and types of sensors, weapons, munitions and communications devices each of which will be simulated individually and be subjected to damage, destruction or suppression. Each system may have its own set of tactics and decision rules. The processes of target acquisition, engagement, damage assessment, communications, ground movement/air flight, decision making/command and control are all explicitly simulated.

CONSTRUCTION:
Human Participation: Not required but may be run in an interruptable mode to permit human decision making.

Time Processing: Dynamic, event-sequenced.

Treatment of Randomness: Deterministic, expected value.

Sidedness: Two-sided, symmetric.

LIMITATIONS: 100 systems on each side.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved treatment of dismounted infantry combat; incorporation of Monte Carlo stochastic mode.

INPUT: Digitized terrain, force organizations and scheme of maneuver, detailed performance of systems and subsystems played.

OUTPUT: Tailored computer printouts with statistical analysis as desired; graphics permit view of the combat and dynamic battlefield environment.

HARDWARE AND SOFTWARE:
Computer(OS): VAX 11/780 (VMS 5.3) or VAX Station 3100 Model 40 (VMS 5.3).
Storage: 4000 blocks.
Peripherals: Printer, graphics workstation/terminal.
Language: FORTRAN 77.
Documentation: User's Manual Published.

SECURITY CLASSIFICATION: Unclassified; data typically classified.

GENERAL DATA:
Data Base: Hours to man-weeks depending on scope of scenario and numbers and types of systems played.

CPU time per Cycle: 10-15 minutes with postprocessing for typical battalion-level scenario of 20 minutes duration.

Data Output Analysis: Hours to man-weeks depending on research issues.

Frequency of Use: Three or more major studies per year.

Users: E&S Corp., U.S. Army TACOM.

Comment: EMC^2 is proprietary software owned by the E&S Corp.

TITLE: Empires in Arms.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and Education.

PROPONENT: Department of History, U.S.A.F. Academy.

POINT OF CONTACT: MAJ Jeffrey D. Jore, AV 259-2022/3230, Commercial (719) 472-2022/3230.

PURPOSE: Empires in Arms is used in support of an upper-division course on the history of the Napoleonic Wars (1792-1815). Designed to expose the students to the nuances of diplomacy, multi-national coalitions and the relationship between economics, society, and military policy.

DESCRIPTION:

Domain: Land and sea.

Span: Europe, North Africa, and the Levant.

Environment: Area-based representation delineated by: 1) national boundaries, 2) department boundaries, and 3) provincial boundaries. Terrain such as forests, mountains, marsh, desert and the like are encountered as well as cities of various sizes and capabilities for defense and logistical support activities. Turns are month-to-month with weather affecting operations in a general way in summer and winter turns.

Force Composition: Joint and combined forces, partisan and irregular warfare. Land and naval forces of England, France, Spain, Austria, Russia, Prussia, and Turkey as well as several minor nations are represented.

Scope of Conflict: Conventional and partisan/irregular warfare.

Mission Area: All conventional and unconventional missions of the era.

Detail of Level of Processes and Entities: Regular and militia infantry portrayed from the brigade to the corps level. Cavalry represented at the division and corps level. Artillery and elite troops as well as partisan and irregular troops represented from small to large-scale units. Naval flotillas, battle fleets and transports portrayed. Strategic and tactical decision-making are continuous. At the tactical level, five standard offensive and six defensive battle formations (i.e., outflank, probe, cordon, etc.) are possible as well as river crossing, amphibious and pursuit operations. The capabilities of individual historical (i.e., Napoleon, Kutusov, Charles, etc.) leaders (tactical and strategic competence and ability to exercise command and control over a number of corps sized elements), type of troops (militia, regular, elite or partisan), and unit morale factors are utilized in combat resolution. Logistics modeled with high resolution. Nations raise manpower, conduct interstate commerce, raise taxes, plan and build their force structure, deal with internal political discontent, etc.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time- and event-stepped model. Progresses through events at a user specified ratio of exercise time to real time.

Treatment of Randomness: Monte Carlo. Up to two six-sided dice are used to generate random numbers. Human rather than machine or computer generated process.

Sidedness: Two-sided through seven-sided asymmetric all sides reactive.

LIMITATIONS: Does not model individual ship-to-ship fighting.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Naval rules enhanced to include individual leaders, shipbuilding (i.e., yard capacity and the like). Political rules expanded.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:
Computer: None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Frequency of Use: Used once per academic year by the U.S.A.F. Academy's Department of History.

Comments: Commercially produced simulation (The Avalon Hill Game Company of Baltimore, MD) adapted for classroom use.

TITLE: EMSA - Electronic Multiple Source Analysis.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: CA1 Group, RARDE, Fort Halstead, Sevenoaks, Kent TN14 7BP.

DEVELOPER: RARDE with support from Logica Defence and Civil Government Ltd.

POINT OF CONTACT: EW Section, CA1 Group, RARDE Fort Halstead, Sevenoaks, Kent, England, P. C. McMahon, 0959-32222 x2353.

PURPOSE:

- To perform the task of intelligence analysis. Provided with many fix reports, each with an emitter position and a position uncertainty ellipse, EMSA has to provide the clearest picture of which elements of the Electronic Orbat have been identified and located. This is principally a data fusion function.

- Two versions of EMSA have been designed and implemented, they are known as Algorithmic EMSA (Alg-EMSA) and Knowledge-based EMSA (KB-EMSA). Alg-EMSA has been developed to provide the fastest picture possible and to cope with large quantity of input.

- KB-EMSA has been developed to a stage of providing comparable results to the Algorithmic approach. The benefits of the KB approach have been recognized as being in the concise expression of domain knowledge required and in the flexibility and extensibility of the application.

INPUT: KB-EMS is interactive; hence it can accept decision making input from the intelligence analyst, and it can maintain multiple views of the given situation presenting the analyst with the most consistent at any one time. In addition, the domain knowledge required for the system's application to intelligence analysis is held in high level constraint form. These English-like statements may be revised readily.

OUTPUT: Emitter positions and corresponding uncertainty ellipses.

HARDWARE AND SOFTWARE:

Computer:	MicroVax II and VAX 11/785 provide the present hardware base.
Storage:	The system required 20 MBytes of core memory and 100 MBytes of disk space.
Language:	VAX VMS DCL command procedures in support of VAX PASCAL and Quintus Prolog coding.

GENERAL DATA:

Frequency of Use: Very frequently.

Users: EW Section, RARDE Fort Halstead, Sevenoaks, Kent.

Comments: Model limitations: thus far, the systems have only focused on single source fusion. Future development: having reached the stage of Alg-EMSA performance with KB-EMSA, the software development program is altering direction.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: EMSARS - Electromagnetic Modeling for Scattering Applied to Remote Sensing.

DATE IMPLEMENTED: 1989.

PROPONENT: Massachusetts Institute of Technology (MIT), Boston, MA.

WORK SPONSORED BY: CECOM Center for Night Vision and Electro-Optics, Attn: AMSEL-RD-NV-VMD-TST, Ft. Belvoir, VA 22060-5677.

POINT OF CONTACT: Thoai Nguyen, C2NVEO, DSN 354-4074, Comm (703) 664-4074.

PURPOSE: The EMSARS model is used in the construction of an integrated simulation model for three dimensional millimeter-wave (MMW) radar scenes with particular emphasis in ground-to-ground systems, and potentially ground-to-air systems. Specifically, the EMARS model is used to model targets and their various features.

DESCRIPTION:

Domain: Target Elements.

Span: Accommodates several different MMW wavelengths (e.g., 35 GHz and 94 GHz) for its predictions.

Environment: EMSARS executes on a Silicon Graphics Workstation.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Multi-Sensor 3-Dimensional Scene Generation.

Level of Detail of Processes and Entities: Feature File Construction: Precise composition and orientation of target data is required to accurately model the power return.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Batch.

Treatment of Randomness: EMSARS is basically a deterministic model.

Sidedness: N/A.

LIMITATIONS: Model has not been validated to completion.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Adding triple-bounce contribution, second-level shadowing, and rough surface scattering.

INPUT: Facetized target file, feature map, dielectric coatings of features.

OUTPUT: Power return graph.

HARDWARE AND SOFTWARE:

Computer(OS):	UNIX operating system; operating on Silicon graphics.
Storage:	Hard disk required.
Peripherals:	Laser printer.
Language:	Believed to be FORTRAN 77, with C subprograms.
Documentation:	Available for MIT.

SECURITY CLASSIFICATION: Unclassified, but restricted distribution to licensees for the source code of EMSARS. Target files may be classified.

GENERAL DATA:

Data Base: Extensive feature map required for accurate simulation of signal returns of target and backgrounds.

CPU time per Cycle: Depends on the size and complexity of the landscape and target.

Data Output Analysis: None provided.

TITLE: EMUD - Engagement Model Update, NonMan (Non-Maneuvering) Code.

MODEL TYPE: Analysis.

PROPONENT: Phillips Laboratory/XPYS, Kirtland AFB, NM 87117.

POINT OF CONTACT: Capt Bruce Gibson, 246-1737.

PURPOSE: An Antisatellite (ASAT) research and evaluation tool used to determine the effectiveness of orbiting, non-maneuvering Directed Energy Weapons (DEW's) against a specified target set.

DESCRIPTION:

Domain: Space.

Span: Global.

Environment: Vacuum.

Force Composition: Only one set of DEW parameters may be run in a given simulation for up to 10 ASAT weapon platforms; i.e., up to 10 identical DEW weapons in uniquely specified orbits (maximum number of ASATs can be increased with a minor code modification).

Scope of Conflict: Either laser or Neutral Partical Beam (NPB) weapons against a specified target set of up to 200 satellites (maximum number of target satellites can be increased with a minor code modification).

Mission Area: Control of space.

Level of Detail of Processes and Entities: User enters DEW parameters, individual target hardnesses (energy deposition required for target negation), and the orbital elements for each target and ASAT platform. Targets may be prioritized, no BM/C3 delay, neither the ASAT or target satellites maneuver.

CONSTRUCTION:

Human Participation: Not required after input file get up.

Time Processing: Time-step with variable step size to iterate to a specified position error.

Treatment of Randomness: Stochastic, Monte Carlo. Random number generator used to advance time to a random value for the start of the "war".

Sidedness: One-sided.

LIMITATIONS: Maximum of ten ASAT platforms and 200 target satellites, maximums may be increased with a minor code modification. Simple Kleperian two-body orbits used, no higher order gravity effects. Lethality value for each target is fixed, lethality dependence on target orientation is not taken into account, no temporary upset or target degradation can be modeled. If more than one ASAT is used, all ASATs must use identical DEWs. Neither ASAT's or targets have maneuver capability.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None, not currently in use.

INPUT: DEW parameters, orbital elements for each target and ASAT platform, duration of war, individual target hardnesses, total number of simulations to be run, whether the start time of the war is to be randomized for each simulation.

OUTPUT: Output file with data on each ASAT/target engagement in each simulation and statistics for the total number of simulations.

HARDWARE AND SOFTWARE:

Computer:	Written to be run on a CRAY, can be modified to run on any system with a FORTRAN compiler.
Storage:	Less that 360 KBytes.
Peripherals:	None required other than to show output.
Language:	FORTRAN.
Documentation:	User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Total CPU time is input dependent, near real time result requires a fast system (on order of a Cray).

Data Output Analysis: System performance numbers immediately available from output.

Frequency of Use: Infrequent. Last used in support of a study in 1988.

Users: None at present.

Comments: None.

TITLE: EMUD - Engagement Model Update, Salloc.

MODEL TYPE: Analysis.

PROPONENT: Phillips Laboratory/XPXS, Kirtland AFB, NM 87117.

POINT OF CONTACT: Capt. Bruce Gibson, 246-1737.

PURPOSE: An Antisatellite (ASAT) research and evaluation tool used to determine the effectiveness of maneuvering space-based Directed Energy Weapons (DEWs) against a specified target set.

DESCRIPTION:

Domain: Space.

Span: Global.

Environment: Vacuum.

Force Composition: Only one set of DEW parameters may be run in a given simulation for up to 5 ASAT weapon platforms; i.e., up to 5 identical DEW weapons in uniquely specified orbits (maximum number of ASATs can be increased with a minor code modification).

Scope of Conflict: Either laser or Neutral Partical Beam (NPB) weapons against a specified target set of up to 50 satellites (maximum number of target satellites can be increased with a minor code modification).

Mission Area: Control of space.

Level of Detail of Processes and Entities: User enters DEW parameters, individual target hardnesses (energy deposition required for target negation), and the orbital elements for each target and ASAT platform. Targets may be prioritized, no BM/C3 delay, ASATs have some maneuver capability, target satellites do not maneuver.

CONSTRUCTION:

Human Participation: Not required after input file set up.

Time Processing: Time-step with variable step size to iterate to a specified position error.

Treatment of Randomness: Stochastic, Monte Carlo. Random number generator used to advance time to a random value for "war".

Sidedness: One-sided.

LIMITATIONS: Maximum of 5 ASAT platforms and 50 target satellites, maximums may be increased with a minor code modification. Simple Kleperian two-body orbits used, no higher order gravity effects. Lethality value for each target is fixed, lethality dependence on target orientation is not taken into account, no temporary upset or target degradation can be modeled. If more than one ASAT is used, all ASATs must use identical DEW's. ASAT maneuvers selected to minimize cost, ASAT does not engage other available targets while maneuvering towards a selected target. Experience has shown that this is not a good code to simulate a target-rich war.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None, not currently in use.

INPUT: DEW parameters, ASAT delta V and guidance accuracy, orbital elements for each target and ASAT platform, duration of war, individual target hardness, total number of simulations to be run, whether the start time of the war is to be randomized for each simulations.

OUTPUT: Output file with data on each ASAT/target engagement in each simulation and statistics for the total number of simulations.

HARDWARE AND SOFTWARE:

Computer:	Written to be run on a CRAY, can be modified to run on any system with a FORTRAN compiler.
Storage:	Less than 360 KBytes.
Peripherals:	None required other than to show output.
Language:	FORTRAN.
Documentation:	User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Unknown. Total CPU time is input dependent, near real time results requires a fast system (on order of a Cray).

Data Output Analysis: System performance numbers immediately available from output.

Frequency of Use: Infrequent. Last used in support of a study in 1988.

Users: None at present.

Comments: None.

TITLE: End-Game.

DATE IMPLEMENTED: 1983, upgraded 1987.

MODEL TYPE: Analysis.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.C. Ondrish, (301) 231-2097.

PURPOSE: End-Game is used by engineers and analysts to evaluate the terminal phase of a missile versus a target (aircraft/missile) engagement.

DESCRIPTION:
Domain: Air.

Span: Area of intercept.

Environment: Air.

Force Composition: One STANDARD Missile (SM) versus one aircraft or missile.

Scope of Conflict: Conventional warhead on SM.

Mission Area: AAW.

Level of Detail of Processes and Entities: This model consists of an interactive graphics program that generates a 3-dimensional picture of the intercept showing both the target and the missile. The advanced graphics program takes about 1 minute 20 seconds to develop the image and about 18 seconds to redraw the image. Redrawing may use one or more of the optional features available, such as zooming, target translation, fuze radar cone alteration, and shading. Image is multi-color, with multi-views, as desired. The graphic display uses a missile-centered coordinate system that provides hidden line removal.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: SM versus target.

LIMITATIONS: Hidden line removal has not been completed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: This model is incorporated into the TOTAL ROUND model for simulation of SM trajectories. It uses the output of TOTAL ROUND, which are kinematic, as well as geometric quantities such as target or missile velocity.

OUTPUT: Graphics

HARDWARE AND SOFTWARE:
Computer: HP 9845C and HP 9020C.
Storage: 170 KBYTES.
Peripherals: Screen copier desirable.
Language: HP Rocky Mountain Basic.
Documentation: Clear notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Program has 2000 lines of code.

CPU time per Cycle: The HP9845C requires 1 minute 20 seconds to develop image and 18 seconds to redraw the image after modification. The HP 9020C requires less time.

Data Output Analysis: N/A.

Frequency of Use: Occasionally needed during fuze studies.

Users: Vitro uses End-Game in support of NSWC, JHU/APL, and NAVSEA.

Comments: N/A.

TITLE: Engage.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SASB), The Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj John Rolando, AFCSA/SASB, ext. 79804.

PURPOSE: Engage estimates the probability of detection and conversion that an air interceptor will detect and convert on a penetrating air vehicle.

DESCRIPTION:

Domain: A c.

Span: Individual.

Environment: Terrain can be varied by changing the backscatter coefficient (varies the clutter).

Force Composition: One penetrator and one interceptor.

Scope of Conflict: Conventional or nuclear.

Mission Area: Strategic or tactical air interdiction.

Level of Detail of Processes and Entities: The entity is individual aircraft or cruise missile, and the process is movement.

CONSTRUCTION:

Human Participation: Required only for setup of parameters.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: No electronic countermeasures, constant speed for penetrator and interceptor, and radar probability of detection and conversion only (no IR or visual).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Speeds, radar cross section, altitude, clutter, kinematics, single sweep detection probability, other radar performance factors, and signal-to-noise criteria.

OUTPUT: Printout of probability of detection and conversion from various attack axes.

HARDWARE AND SOFTWARE:

Computer:	IBM 3081 or a VAX 11/780.
Storage:	N/A.
Peripherals:	N/A.
Language:	FORTRAN H extended.
Documentation:	Engage User's Manual.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:

Data Base: Few hours.

CPU time per Cycle: A typical case takes about one real-time minute.

Data Output Analysis: One week.

Frequency of Use: Varies depending on SASB analytic requirements.

Users: SASB.

Comments: None.

TITLE: EO-SIM - Electro-Optic Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Electro-optical sensor image simulator.

PROPONENT: Night Vision Lab.

POINT OF CONTACT: John Horger, AV 354-5845, Comm (703) 664-5847.

PURPOSE: EO-SIM is used for comparative analysis of FLIR sensor design.

DESCRIPTION:

Domain: Scanning and storing thermal imagers. Extendable to TV and near IR imagers.

Span: Covers wavelength region from 0.3 to 12 microns. Wavelength region can be extended.

Environment: Simulation is run on a PC or a UNIX workstation in a laboratory. The sensor can be used anywhere.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:

Human Participation: Human supplies input digital image and numerical values for sensor parameters and gets as output simulated sensor image.

Time Processing: Output is an image sequence with time varying noise appropriate to the sensor. Frames are stored on hard disk and displayed with a speed dependent on the disk access and video monitor. Each input image is processed for about 2 minutes on a Sun workstation before being stored on hard disk.

Treatment of Randomness: Noise is added at the detector output. Noise amplitudes are random Gaussian variables. A 3-D noise description is used. This consists of seven noise terms: (1) horizontal; (2) vertical; (3) temporal; (4) horizontal-vertical; (5) horizontal-temporal; (6) vertical-temporal; and (7) horizontal-vertical-temporal.

LIMITATIONS: Parameter choice can slow processing speeds. Image size can be limited by available memory. Simulation assumes a linear system and makes other approximations. Simulation does not include atmospheric effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Check supplies inputs for reasonableness. Gain and level controls. Improve documentation.

INPUT: Image and sensor parameters.

OUTPUT: A simulated monochrome image.

HARDWARE AND SOFTWARE:

Computer:	Works on a PC under DOS. Works on a SUN workstation under UNIX.
Storage:	Minimum storage required is 3 Meg of disk space and 640 K of RAM.

Peripherals: Needs 8 bit video display; i.e., 256 gray levels.
Language: C.
Documentation: Minimal documentation exists at this time.

SECURITY CLASSIFICATION: The work is unclassified.

TITLE: EOVAC - Electro-optical Vulnerability Assessment Code.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: HQ AFOTEC/OAN (Modeling & Analysis Division) Kirtland AFB, NM 87717-7001.

POINT OF CONTACT: Ms. Cheryl Black, AV 246-1938.

PURPOSE: EOVAC is used for laser threat engagement modeling and system vulnerability assessment.

DESCRIPTION:
Domain: Land and air.

Span: Any theater depending on the data base. Currently, the data base is limited.

Environment: Laser threat damage and influences of battlefield visual obscurants. Day and night conditions.

Force Composition: BLUE vs. RED.

Scope of Conflict: Conventional warfare, few-on-few engagements; emphasizes optical and electro-optical susceptibility and vulnerability.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Depends on the level of detail of systems description in the data base. Retinal damage and battlefield obscurant effects are highly detailed.

CONSTRUCTION:
Human Participation: Needed prior to runs for scenario description and after run is complete to interpret results.

Time Processing: 10 times slower than real time.

Treatment of Randomness: All attrition based on direct computation of probabilities of detecting identified hit (time lapsed). Monte Carlo determination of results (user option).

Sidedness: Two-sided, reactive model.

LIMITATIONS: Data base is currently very limited.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Build data base and graphics.

INPUT: Terrain, weapons description and location, and vulnerabilities definitions.

OUTPUT: Retinal damage (eyes); laser damage, BLUE and RED movements during engagement; probabilities of detect, id, hit, kill; and miss distances.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/785 or comparable machine (VMS).
Storage:	1500 blocks (10 MB).
Peripherals:	VT100 terminal, printer.
Language:	FORTRAN 77.

Documentation: User's manual, data base specifications, and maintenance manual.

SECURITY CLASSIFICATION: Depends on data base (unclassified or secret).

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: 15 minutes to 1 hour of CPU time.

Data Output Analysis: Depends on site of engagement and options played.

Frequency of Use: Currently testing and verifying code.

Users: HQ AFOTEC/OAN, AFCSA/SAGR (new), and AFWL.

Comments: N/A.

TITLE: Error Analysis Using Multiple Ellipse Techniques for Use on Airborne Vehicles.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: CECOM AMSEL-PL-SA, Fort Monmouth, NJ 07703-5000.

POINT OF CONTACT: Ms. Valerie Ingels, (201) 532-4381, AV 992-4381.

PURPOSE: This research and evaluation tool enables an analyst to use the Error Analysis Model (ERAN) to perform an error analysis of a line-of-bearing target location system using multiple ellipse techniques.

DESCRIPTION:
Domain: Any combination of the identified items.

Span: Local.

Environment: N/A.

Force Composition: Component and element.

Scope of Conflict: Conventional.

Mission Area: Air, land, and sea.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:
Human Participation: Required for input data.

Time Processing: Static.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: One-sided.

LIMITATIONS: Single target.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Angle measurement, error-of-sensor, and other data identified in the 31 May 1988 user's guide and program documentation.

OUTPUT: Statistically analyzed data and other analysis (see 31 May 1988 user's guide and program documentation).

HARDWARE AND SOFTWARE:

Computer:	Any.
Storage:	Minimum storage required.
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	The ERAN model documentation includes a user's guide and program documentation manual that is located at the CECOM P&O Directorate, Fort Monmouth, NJ.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: Negligible.

Data Output Analysis: Computer output is self-instructive and complete.

Frequency of Use: N/A.

Users: CECOM Center for Electronic Warfare/Reconnaissance Surveillance and Target Acquisition, Fort Monmouth, NJ.

Comments: N/A.

TITLE: ESAMS - Enhanced Surface-to-Air Missile Simulation.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Fraley, DSN 225-5550 or Commercial (703) 695-5550.

PURPOSE: ESAMS generates one-on-one probabilities of kill for BLUE aircraft versus RED surface-to-air missile systems. The results are used in higher level survivability analyses to evaluate weapon system effectiveness.

DESCRIPTION:

Domain: Air and land.

Span: Individual.

Environment: Terrain relief and sea states.

Force Composition: Element.

Scope of Conflict: Conventional.

Mission Area: Supports all mission areas that encompass survivability of penetrating aircraft encountering surface-to-air missile systems.

Level of Detail of Processes and Entities: Single aircraft versus single missile system. Attrition.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo (also has a deterministic mode).

Sidedness: One-sided.

LIMITATIONS: Scenarios are limited to single aircraft or to two-ship formations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved waveform modeling, addition of new SAM systems, improved ECCM modeling, improved user friendly interface.

INPUT: Aircraft radar and infrared cross sections, aircraft and component vulnerability characteristics, radar characteristics, missile performance, aircraft performance, aircraft flight paths, terrain data, electronic countermeasures characteristics.

OUTPUT: Computer printouts of missile and target flight paths and detailed endgame analyses, plots, raw data, and statistically analyzed data. Outputs can be analyzed using GRIPS graphic interface tool.

HARDWARE AND SOFTWARE:

Computer:	IBM 3081 (MVS), VAX 11/780 (VMS), CDC CYBER, SUN (UNIX) FORTRAN 77.
Storage:	Requires 10 MB available memory.
Language:	FORTRAN.

Documentation: Documentation available from SURVIAC (Model Repository), Wright-Patterson AFB, OH.

SECURITY CLASSIFICATION: Secret/NoForn/WNINTEL with basic data sets.

GENERAL DATA:

Data Base: Varies from one hour to several days depending on the data file, availability of the input data, and expertise of the user.

CPU time per Cycle: Depends on the complexity of the SAM and the scenario. One shot typically takes approximately five minutes. Adding terrain, ECM, and complex waveform options will increase run time.

Data Output Analysis: Minutes to days depending on the application.

Frequency of Use: Daily.

Users: AFSAA/SAG, AFOTEC/OA, ASD/EN, HQ SAC, NWC, NADC, FTD, others.

Comments: ESAMS can be linked to other models/analysis processes such as TAC REPELLER, ACES/PHOENIX, SUPPRESSOR, and PENETRATOR.

TITLE: ESIM - Evolutionary Surface-To-Air Missile Simulation.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Hughes Aircraft Company, Missile Systems Group, 8433 Fallbrook Avenue, Canoga Park, CA 91304.

POINT OF CONTACT: R.A. Davison, (818) 702-3118; E.M. Fairly, (818) 702-2617; K.H. Henry, (818) 702-1599.

PURPOSE: ESIM is a flexible many-versus-many air defense research and evaluation tool. It is designed to evaluate the effectiveness of mixes of air defense systems and interceptors against realistic threat scenarios. ESIM is used in conjunction with digital terrain analysis tools and graphics replay tools for evaluation of tactical air defense architecture concepts. The principal analysis applications of ESIM include weapon systems development, system effectiveness, and force capability and requirements assessment.

DESCRIPTION:

Domain: Land and air.

Span: Accommodates theater air defense activities depending on data base. Data bases include several worldwide geographical areas.

Environment: May include terrain features such as elevation, trees, hills and cities.

Force Composition: Blue and Red force weapons elements (weapon, sensor, C3, air threats, etc.).

Scope of Conflict: Guided missiles (passive, inertial, semi-active), ADA guns, airbreathing threats and anti-ballistic missiles.

Mission Area: Air defense, defensive counter air.

Level of Detail of Processes and Entities: Entities include guided ballistic missiles, fire-units, ground sensors, formation of aircraft, and command and control communication systems.

CONSTRUCTION:

Human Participation: There is no human participation. Once the model is executed it cannot be halted or interrupted.

Time Processing: ESIM is a dynamic, event-stepped and continuous process model.

Treatment of Randomness: ESIM utilizes a Stochastic, Monte Carlo method of randomness.

Sidedness: Two-sided, asymmetric, BLUE reactive.

LIMITATIONS: Computer resources limit the number of players. Although ESIM was primarily designed to model ground-to-air scenarios, it also models air-to-ground scenarios. Air-to-air capability is somewhat limited.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model is continually being improved and enhanced.

INPUT: The input to the ESIM model consists of a detailed description of the setup of the air defense battle scenario. The types and number of nets, aircraft, sensors, launchers and missiles are specified in the input as well as other scenario inputs such as firing doctrine, target flight plans, line-of-sight coverage, time delays, digital terrain and mask/unmask times.

OUTPUT: The ESIM model outputs a final disposition for each missile, including target range at launch and range at intercept. An event by event account of the engagement is available when desired. A statistical summary of several effectiveness measures is provided for each scenario. Histograms of detection, track, launch, and intercept range are also provided. Computer graphic replay of a combat scenario is available.

HARDWARE AND SOFTWARE:

Computer(OS):	ESIM is designed to run on a VAX (8800, 8650, 3000) computer with a VMS operating system.
Storage:	4 Megabytes: programs; inputs; terrain LOS data; outputs.
Peripherals:	Printer and terminal.
Language:	ESIM consists of approximately 30K lines of SIMSCRIPT II.5 code. It also interfaces with FORTRAN routines.
Documentation:	ESIM User's Manual, July 1991. ESIM Programmer's Manual, July 1991. ESIM Overview Briefing, March 1991. Macintosh Computer Graphic Replay Demonstration.

SECURITY CLASSIFICATION: The model is unclassified.

GENERAL DATA:

Data Base: Depending on the complexity of the scenario, the preparation of a data base can vary from a couple of days to a month.

CPU time per Cycle: A very short run can be completed in less than 30 seconds of CPU and large, extensive runs can easily exceed over eight hours of CPU time. Typically runs average 20 minutes of CPU.

Data Output Analysis: Postprocessor aids in analysis of output. Computer graphics play scenario events.

Frequency of Use: Weekly.

Users: Hughes Aircraft Company.

Comments: Various ancillary computer programs support ESIM use.

TITLE: EWS - Electronic Warfare Simulation.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: CA1 Group, RARDE, Fort Halstead, Sevenoaks, Kent, TN14 7BP.

DEVELOPER: RARDE with support from Logica Defence and Civil Government Ltd.

POINT OF CONTACT: EW Section, CA1 Group, RARDE Fort Halstead, Sevenoaks, Kent, England, P. C. McMahon, 0959-32222 x2353.

PURPOSE: Communication system studies using models of communication systems, EW equipments and electromagnetic environment.

DESCRIPTION: The Electronic Warfare Simulation (EWS) is used to investigate the performance of electronic systems on a battlefield. It is interactive in the sense that side can try to optimize its capabilities, within a changing environment, by adjusting parameters such as position, antenna height, power and frequency.

INPUT: The EWS takes as input snapshots of the scenario of interest, communications and non-communications set details and system specifications, plus corresponding digital terrain data. Each snapshot represents a deployment up to Corps size at a given instant of interest within the scenario.

OUTPUT: The EWS can provide communications performance metrics for a variety of electromagnetic environments. More often use is made of built in statistical summary functions giving performance at the network level.

HARDWARE AND SOFTWARE:

Computer: The EWS requires 20 MBytes of core memory, is run efficiently in a virtual memory environment. It is presently based on a VAX 6000-440, though with corresponding run time penalties, it may be configured onto a VaxStation 3100 with 24 MBytes of memory.

Storage: It requires at least 150 MBytes of disk space. The present system uses DEC RA90 drives, providing a total of 7.6 GBytes disk capacity.

Language: VAX FORTRAN; uses supporting VMS DCL command files.

GENERAL DATA:

Data Base: Typical run-rates on the VAX 6000-440 are 15:1 real time.

CPU time per Cycle: 15 minutes of real time to 1 minute of simulated time.

Frequency of Use: Very high. The EWS is under constant development to answer the needs of multiple studies.

Users: EW Section, RARDE Fort Halstead, England; EW Section, ORAE, Canada.

Comments: Release version at time of compilation is Version 3.0.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: FAASRAM - Facility Air Attack Requirements Assessment Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Naval Facilities Engineering Command.

POINT OF CONTACT: Naval Civil Engineering Laboratory, J.M. Ferritto, AV 551-1243 or Commercial (805) 982-1243.

PURPOSE: Perform detailed facility damage assessment from air attack.

DESCRIPTION:

Domain: Land.

Span: Base level.

Environment: Model of base including pavements, buildings, utilities, and resources.

Force Composition: Joint Red and Blue.

Scope of Conflict: Air attack.

Mission Area: Conventional weapons.

Level of Detail Processes and Entities: Detailed base assessment of damage using Monte Carlo iteration and NCEL damage function.

CONSTRUCTION:

Human Participation: Model input and threat definition.

Time Processing: Progresses through time phased air attacks.

Treatment of Randomness: Uses weapon REP, DEP and CEP, weather and other variables such as ground defense.

Sidedness: One-sided.

LIMITATIONS: PC-Based System.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Further work in utility systems and damage function. Currently under development.

HARDWARE AND SOFTWARE:

Computer:	MSDOS 286/386.
Storage:	640K.
Peripherals:	Printer and Plotter.
Language:	C.
Documentation:	Under development.

SECURITY CLASSIFICATION: Model without data "Unclassified."

GENERAL DATA:

Time Requirements: Varies with detail.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: FACTS - Fleet AAW Model for Comparison of Tactical Systems.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Weapons Effectiveness Branch (G11) of the Systems Analysis Division, Naval Surface Warfare Center, Dahlgren, VA 22448-5000.

POINT OF CONTACT: Mr. James Elmlinger, AV 249-8851, Comm (703) 663-8851.

PURPOSE: FACTS was developed to satisfy a need for a software tool that would be capable of investigating the effectiveness of Naval AAW weapon system concepts and upgrades while being simple enough to implement on high performance microcomputers. FACTS is primarily an AAW firepower model with multi-ship, multi-layer, multi-threat, and multi-raid capabilities. It will accommodate multi-layer shipboard defenses against varied threat types. Different firing doctrines and layer selection algorithms may be implemented for each ship.

DESCRIPTION:

Domain: Sea and air.

Span: Has been used to model a single ship defending itself as well as a task force (SAG, 2 CV Battlegroup, etc.) engaged in AAW.

Environment: No explicit model of the environment is used. The effects of certain phenomena can be accounted for by adjusting system performance parameters (e.g., detection range, probability of kill, etc.).

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional AAW. Considers BLUE shipboard systems and RED ASCMs only. The Outer Air Battle is not modeled, and there are no provisions for modeling aircraft.

Mission Area: AAW.

Level of Detail of Processes and Entities: The lowest BLUE entities modeled include missiles/bullets, launchers, and sets of illuminators and midcourse channels. The lowest RED entity modeled is an ASCM. Missile flyout is handled by a range/time-of-flight table, while missile kinematic capability is modeled by two hemiellipsoids which define the missile's min and max intercept boundaries. Launchers are characterized by slew time, firing rate, reload delays, and magazine capacity. If required, sets of illuminators may be defined for each defensive layer on a ship, or a single set may be shared between the primary and secondary layer. A single set of midcourse channels may be specified for each ship. Detection and tracking of RED ASCMs is handled with fixed detection ranges for each ship/threat-type combination and with either a fixed or a random time to establish a firm track. In addition, user specified initial reaction delays and track channel limitations impact the ability of a ship to establish a firm track. The RED ASCM itself is modeled as either a 1, 2 or 3 legged trajectory together with a range-to-impact/time-to-go table. The end-game is handled with a probability-of-kill/intercept-range table.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: FACTS is a dynamic, event-stepped model.

Treatment of Randomness: Stochastic, Monte Carlo model.

Sidedness: Two-sided, asymmetric model. Nonreactive threat.

LIMITATIONS: At most two integrated weapon systems per ship plus one point-defense system. No explicit coordination algorithm. Number of entities is limited only by the amount of virtual memory available.

PLANNED IMPROVEMENTS AND MODIFICATIONS:

INPUT: Weapon/threat descriptions, scenario data.

OUTPUT: Tables of summary statistics and a file containing a detailed event chronology for each replication. The latter is used as a data base for various postprocessors.

HARDWARE AND SOFTWARE:

Computer(OS):	VAX 11/780 and MICROVAX II (VMS).
Storage:	≥22000 blocks (about 1 Meg.), 20000 blocks typically.
Peripherals:	Printer, Tektronix graphics terminal (optional).
Language:	PASCAL.
Documentation:	FACTS Users Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Simple scenario requires less than 8 hours.

CPU time per Cycle: Typically, less than 1 minute.

Data Output Analysis: Cursory look; less than 8 hours.

Frequency of Use: Currently, used almost every day.

Users: NSWC, NAAW.

Comments: Managed through the FACTS Steering Group (FSG). Continually updated based on priorities established by the FSG.

TITLE: FALCON.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: U.S. ACDA.

POINT OF CONTACT: CDR R.J. Larkin, U.S. ACDA, Operations Analysis Group, 320 21st St. NW, Washington, DC 20451.

PURPOSE: FALCON is used to analyze strategic force postures and strategic targeting doctrines.

DESCRIPTION:

Domain: Abstract.

Span: Global.

Environment: N/A.

Force Composition: Blue or Red Strategic Forces (ICBMs, SLBMs, Bombers).

Scope of Conflict: Strategic nuclear.

Mission Area: Strategic missions.

Detail of Level of Processes and Entities: Individual strategic nuclear delivery vehicles.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Rigid input data format, limited output tables.

INPUT: Force structures, weapons characteristics, scenario, target characteristics.

OUTPUT: Computer printouts of weapon allocations and estimated damage.

HARDWARE AND SOFTWARE:

Computer:	IBM compatible PCs, VAX minicomputer.
Storage:	Approximately 300 kilobytes for source code and 400 kilobytes for model execution.
Peripherals:	Standard text printer.
Language:	FORTRAN 77.
Documentation:	RAND note N-3195-AF.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Initial Data base: 3 hours. Changes: 10-15 minutes.

CPU time per Cycle: Total execution time for moderate problems (20 weapon types, 60 target objectives) - approx. 1.5 minutes.

Data Output Analysis: 30 minutes.

Frequency of Use: During Studies, 10-20 times daily.

Users: RAND, U.S. ACDA.

TITLE: FASAM - Force Attack Static Analysis Model.

DATE IMPLEMENTED: Version 1.0 December 1990, and version 1.1 August 1991.

MODEL TYPE: Analysis.

PROPONENT: Operations Research Division, SHAPE Technical Centre, Oude Waalsdorperweg 61, P.O. Box 174, 2501 CD, 's-Gravenhage, The Netherlands.

POINT OF CONTACT: N. M. Harris, Tel: (070) 3142311; FAX: (070) 3142111.

PURPOSE: FASAM is a static tool, which may be used to allocate assets to a predetermined set of objectives. This allows a given weapon distribution to be analyzed to determine potential shortfalls and surpluses.

DESCRIPTION:
Domain: Abstract domain which may be used to represent air, land, or sea operations.

Span: From regional to theatre.

Environment: No representation of terrain, culture, or weather.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Weapon effectiveness is user specified. Therefore, the model is suitable to assess conventional, special, or rear area weapons.

Mission Area: Any mission, that can be described by linear objectives and effectiveness measures, may be represented

Level of Detail of Processes and Entities: Entities are described by position and a linear measure of 'effectiveness' or 'hardness'. Therefore, any collocated elements with similar effectiveness/hardness characteristics may be represented by single entities.

CONSTRUCTION:
Human Participation: Not required or permitted.

Time Processing: Static.

Treatment of Randomness: Deterministic - no random representation.

Sidedness: Without interaction two-sided symmetric, or one-sided.

LIMITATIONS: Model only suitable for snap-shot analysis. No Red/Blue interactions or direct representation of factors such as ground base air defence. DOS operating system provides a limit on number of entities that may be considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Data specifying weapon effectiveness, force multiplier effectiveness, target locations, weapon locations, and force multiplier locations.

OUTPUT: Output tables providing suggested optimal allocation of weapons to targets. Output provides details of range limitations, surplus capacity, and shortfalls. An additional output file is produced, that is formatted for direct import into a spreadsheet program (Excel).

HARDWARE AND SOFTWARE:

Computer:	Runs on an IBM PC compatible PC under DOS.
Storage:	2 megabytes - although additional working space is desirable for input and output files, and compiler for program modifications.
Peripherals:	Minimum requirements - 640 kilobytes memory and printer.
Language:	Microsoft FORTRAN 4.1.
Documentation:	(a) 'FASAM General Description and User Guide', STC TN 368 (b) 'FASAM Program Manual', STC TN 369 (c) FASAM Version 1.1 to be published.

SECURITY CLASSIFICATION: NATO Unclassified.

GENERAL DATA:

Data Base: Time for generation of data base is problem dependent. However it is not likely to exceed one man month.

CPU time per Cycle: Problem and PC type dependent. Five minutes would be a typical run time for an 'average' problem on IBM model 70.

Data Output Analysis: Tabular summary files, and direct import into PC based spread sheet programs.

Frequency of Use: It has been in regular use since October 1990.

Users: ORD, SHAPE Technical Centre in support of SHAPE.

Comments: Model performs allocation by using a linear programming routine.

TITLE: FASTALS - Force Analysis Simulation of Theater Administrative and Logistics Support.

DATE IMPLEMENTED: 1971.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Mr. Raymond McDowall, DSN 295-0027 or (301) 295-0027.

PURPOSE: The objective of FASTALS is to develop the balanced, time-phased support force requirements for a specified combat force. FASTALS is used primarily for force planning studies and analysis generally in the context of the Defense Guidance Illustrative Planning Scenario (DGIPS).

DESCRIPTION:

Domain: Land.

Span: Each run accommodates one theater with a specified combat force in a combat scenario.

Environment: Theater dependent.

Force Composition: Specified by study sponsor and used to generate requirements for Army logistical units.

Scope of Conflict: N/A.

Mission Area: FASTALS is a deterministic computer program that was developed to generate the time-phased Army support requirements that result from a given combat simulation.

Level of Detail of Processes and Entities: Support requirements are generated for each unit type (functional area) including engineer, chemical, medical, transportation, ordnance, quartermaster, etc., by Standard Requirements Code (SRC). The workload requirements needed to sustain the forces are also generated and displayed. Workloads include maintenance, construction, supply consumption, transportation, patient care, personnel replacements, other.

CONSTRUCTION:

Human Participation: All inputs are developed by functional area analysts prior to model execution. No interaction is permitted during model execution.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: No attrition to support units or retrograde movement operations; single movement of units and supplies from point of arrival to destination.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Continue to develop routines to facilitate and enhance data entry and retrieval.

INPUT: The following data base in magnetic tape form are used: Military Traffic Management Command weights file, Army MARC Maintenance Data Base, Force Accounting System unit data, and Consumption factor data (provided on floppy disks) from the U.S. Army Logistics Center.

OUTPUT: Force listing is in the form of a time-phased troop list indicating unit requirements by SRC.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1100/84.
Storage:	1.5 megabytes.
Peripherals:	Two 9-track, 6250 byte-per-inch tape drives.
Language:	FORTRAN 77.
Documentation:	User's Manual and Programmer's Guide.

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:

Data Base: One man-month or more depending on size of force and complexity of theater being evaluated.

CPU time per Cycle: Thirty (30) minutes.

Data output Analysis: Two weeks or more depending upon theater.

Frequency of Use: Used approximately 30 times per year for record runs.

Users: U.S. Army Concepts Analysis Agency, U.S. Army Logistics Center, U.S. Army Logistics Evaluation Agency.

Comments: This model has been used for 20 years to develop the support force requirements for the Army and is accepted as the standard by which other models are measured.

TITLE: FASTGEN 3 - Fast Shotline Generator.

DATE IMPLEMENTED: September 1986.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: FASTGEN 3 is a model for describing the geometry and internal components of aircraft for use in nonnuclear vulnerability assessments.

DESCRIPTION:
Domain: Air and land.

Span: Individual.

Environment: N/A.

Force Composition: Element.

Scope of Conflict: Conventional.

Mission Area: N/A.

Level of Detail of Processes and Entities: FASTGEN 3 is a program to automate the construction of geometric models of military vehicles. FASTGEN 3 can be used to model a vehicle's skin, structure, and internal components. The geometric model is constructed based on the assumption that all surfaces can be described by a series of adjacent triangles, cones, cylinders, spheres, and rods. The resultant data is stored for later use in vulnerability computation programs for projectile, fragment, and laser threats.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: FASTGEN 3 models only one target at a time. Body shapes are approximated using triangles, cones, spheres, or rods.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: FASTGEN 3 inputs include a binary target description, azimuth data, and elevation data.

OUTPUT: FASTGEN 3 produces a LOS data file and target summary file. The target summary file records possible component interferences and errors encountered in processing geometric target descriptions.

HARDWARE AND SOFTWARE:
Computer: VAX and MicroVAX.
Storage: 100 KB.
Peripherals: N/A.
Language: FORTRAN IV.
Documentation: FASTGEN 3 User's Manual

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: Fast Stick.

DATE IMPLEMENTED: February 1988.

MODEL TYPE: Training and Education

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: Fast Stick, a seminar exercise driver, teaches the basic tactical employment concepts of air superiority, interdiction, close air support, and reconnaissance.

DESCRIPTION: Fast Stick addresses basic concepts for planning employment of tactical air forces. The scenario encompasses the first 72 hours of an air campaign. Players apply basic tactical employment concepts of reconnaissance, counter air, interdiction, and close air support.

Domain: Air operations against land and air targets.

Span: Present data base accommodates only a fictional location.

Environment: Fast stick models both day and night operations and weather.

Force Composition: Air assets only.

Scope of Conflict: Conventional warfare only.

Mission Area: Conventional mission including: reconnaissance, electronic warfare, air defense, air offense, close air support and interdiction.

Level of Detail of Processes and Entities: Tactical Air Control Center Level.

CONSTRUCTION:

Human Participation: Required for processes and decisions.

Time Responses: Dynamic time- and event-stepped model.

Treatment of Randomness: Stochastic; attrition and targeting based on Monte Carlo determination.

Sidedness: Two-sided, asymmetrical model, with the computer playing the side of the opposition.

LIMITATIONS:

PLANNED IMPROVEMENTS AND MODIFICATIONS: AFIT is developing a data base-driven version of the model.

INPUT: Players determine role of aircraft (CAS, RECCE, etc.), weapon loads, mission packaging, target allocation, spares allocation, response to tactical air requests, and response to enemy attacks.

OUTPUT: Fast Stick produces printed reports on the following subjects: planned mission summary, aircraft allocation and weapons load summary, target summary, and day and night aircraft status reports. It also provides an end-of-day summary including point total.

HARDWARE AND SOFTWARE:

Computer (OS): IBM-compatible MS-DOS machine with floppy and hard-disk drive storage and 640 kilobytes random access memory. Fast Stick also requires a printer and monitor (color is optional, but preferred).

Storage: Requires 1.0 megabyte for executable and 0.5 megabyte for disk work space.

Peripherals: Monochrome monitor (color optional) and printer.

Language: MS-Pascal and MS-Assembler.

Documentation: User and Maintenance Manuals available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Requires about 2 man-weeks to key in new data base.

Data Base: Occupies about 80 kilobytes.

CPU time per Cycle: Not applicable.

Data Output Analysis: Fast Stick includes a monitor program to recover errors by both system and user. It also allows for hardcopy analysis.

Frequency of Use: Used annually by Air Command and Staff College (ACSC). Use frequency by other users unknown.

Users: ACSC; Marine Command and Staff College; and Command and General Staff College, Ft Leavenworth.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: FB:B-C(A) - First Battle: Battalion Through Corps (Automated).

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and Education.

PROPONENT: U.S. Army Combined Arms Command-Training, ATTN: ATZL-CTS-BB, Ft Leavenworth, KS 66027-7301.

POINT OF CONTACT: CPT John Hughes, (913) 684-3189, AV 552-3189/3395.

PURPOSE: FB:B-C exercises unit commanders and staffs in the control and coordination of combined arms operations in a simulated combat environment or Command Post Exercise (CPX). Exercises a unit's tactical SOPs.

DESCRIPTION:

Domain: The model plays land, air and sea.

Span: Any map - theater to local.

Environment: Played on standard maps. Plays day/night. Models roads, bridges, cities and obstacles.

Force Composition: Any force.

Scope of Conflict: Plays all weapon systems including NUC/CHEM.

Mission Area: Conventional force to corps.

Level of Detail of Processes and Entities: Army to single soldier.

CONSTRUCTION:

Human Participation: Human participation required for decisions and to process model.

Time Processing: Static.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetrical.

LIMITATIONS: No graphics or terrain representation. Depends on map board and unit counters. Is game turn dependent.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Update user and training documentation.

INPUT: Movement/critical orders, unit names/locations, resupply, scenario.

OUTPUT: Conflict resolution, battle damages, personnel and logistics, losses and reports.

HARDWARE AND SOFTWARE:

Computer(OS):	IBM compatible PC. MS DOS 3.2 or better.
Storage:	10 megabyte hard disk with a minimum of 5 megabytes free.
Peripherals:	Epson-type printer.
Language:	Turbo Pascal 5.5
Documentation:	Installation guide, Basic Rules and Supplements for play.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1 day.

CPU time per Cycle: Unknown.

Data Output Analysis: N/A.

Users: Commanders and staffs, battalion through corps.

TITLE: FDE - Force Deployment Estimator.

DATE IMPLEMENTED: First prototype delivered December 1990. Second prototype anticipated October 1991.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Room 1D940, Washington, DC 20318-8000.

POINT OF CONTACT: Ground Forces Branch, CFAD, (703) 614-4767.

PURPOSE: FDE is a force deployment model which is designed to provide a first cut estimate of the feasibility of a desired deployment of ground, sea, and air forces and their sustainment world wide.

DESCRIPTION:

Domain: Air, land, and sea. Geography represented as distance and transit time. Ports/airports represented as loading/unloading times and capacities.

Span: Theater or multitheater. Simultaneous multitheater capability.

Environment: Time, distance, and capacity parameters can be adjusted to reflect specific environments.

Force Composition: Transport means (carriers) can consist of any combination of civil and military transport aircraft, ships, railroads, trucks, etc. Forces to be deployed can be of any size and combination.

Scope of Conflict: Not a combat model.

Mission Area: Force generation, transport, and resupply.

Level of Detail of Processes and Entities: Carrier movement is simulated from load origin to destination at the individual carrier level. Units to be moved can be of any size.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic event-stepped model.

Treatment of Randomness: Deterministic in treatment of transport times, distances, carrier availability. Research project anticipated to introduce stochasticity of these types of model elements. Search for a solution is based on a stochastic search using a technique called "sir ted annealing" to explore the vicinity of a "las b t" solution in the for a better one. When a solution is found that satisfies user-specified g the search is ended.

Sidedness: One-sided.

LIMITATIONS: Aggregated unit descriptions (non-TPFDD level) produce results that estimate closure. Degree of agreement with "accepted" transport models awaiting further testing.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A follow-on effort to introduce stochasticity of certain parameters is anticipated.

INPUT: Requires that the number, type, availability (time) and specific capacities of each carrier be entered. Specific capacity is in terms of the amount by type ton would be loaded "on the next carrier" for each type of unit being moved. Current data used was developed for the 1991 Mobility Requirements Study. Geography is described as carrier network paths (time and distance) which could be utilized from unit load origins to destinations. Return paths are specified to enable carriers to be redistributed if needed. Units to be moved are described in terms of bulk, oversized, and outsized tons and passengers to be moved. Supply is described in terms of unit daily consumption rates for "ammo" and "other" consumables.

OUTPUT: Reports are provided on the proximity of the current "last best" solution to the specified goals as the model searches for a sufficient solution. When a solution is found (or the run is terminated) reports on the specific solution found (or last-best in the case of a nonsufficient solution) are provided. These reports allow the user to understand the process of the deployment from the perspective of carrier utilization, unit times, supply sufficiency, or other viewpoints. A complete history of the deployment is also available.

HARDWARE AND SOFTWARE:

Computer:	Sun with SunOS; +Alliant for using the parallel search option.
Storage:	Unknown.
Peripherals:	Printer.
Language:	FORTRAN 77, INGRES, Simplifies SQL, X Windows.
Documentation:	Under development.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Initial setup can be performed in hours.

CPU time per Cycle: 15 sec for medium-sized problem.

Data Output Analysis: Using Simplified SQL as the postprocessor allows rapid construction of additional tables, charts, and graphs based upon model output if available outputs are insufficient.

Frequency of Use: Unknown.

Users: CFAD/J-8.

Comments: A flexible prototype force deployment model using a novel combination of simulation, goal programming, and simulated annealing.

TITLE: FIRST - Fighter Infrared Search and Track.

DATE IMPLEMENTED: 1986.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay,WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The FIRST model will allow one who has some knowledge of infrared search and track (IRST) systems to perform analyses of an IRST's capabilities. The FIRST program allows the user to model a complete IRST scenario. The user can then perform parametric variations to parts of the scenario to characterize the IRST's overall performance against a variety of conditions.

FIRST was developed to aid in the investigation of the expected performance capabilities of an IRST set to detect targets in cluttered backgrounds. The FIRST model allows the user to generate probabilities of detection versus range-to-target. The probabilities of detection are calculated for a given false alarm rate (FAR). This measure of performance (probability of detection (PD) and FAR) is useful for averaging the performance of the IRST over a range of operational conditions.

DESCRIPTION: The program can be utilized to perform an analysis of a proposed IRST or an existing system. The model determines detection probabilities statically since the target is assumed to be within the field-of-view (FOV) and its position is known. The calculations are performed dynamically since the detector scan is performed as a function of time.

The user specifies the sensor, background, target, and atmosphere that describes the IRST scenario. The model will handle the scanning of the IRST's sensor FOV within a background by a linear array of detectors. The program projects each detector along an image line in the scan direction to the object plane (background image). The program obtains the radiance values from the background as viewed by each detector and propagates these values through the atmosphere using LOWTRAN 6. The model also includes the effects of the optics and any transmission losses through the optics. A random noise is added to the resulting voltage from each detector due to the detector and preamplifier electronics based on the noise equivalent irradiance (NEI).

The process of scanning the background is performed twice. The first scan processes the background while the second scan places the target into each point in the background and processes the target in the background. This process is continued until the entire sensor FOV has been scanned. The resulting data is then stored on disk for use in calculating PD and FAR. Tracking algorithms are not provided; however, the intermediary files stored could be utilized in generating track information.

INPUT: The FIRST model requires a main input data file which sets up initial conditions and geometries, interactive inputs for setting up additional inputs and outputs, and other miscellaneous files based on options selected, such as map variation inputs for setting up background imagery.

OUTPUT: Several outputs exist, depending on input options selected. Outputs include map variation outputs, target variation outputs, background image, target in background. Most output files are arrays of values, with units of volts.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage: 8,356,864 bytes.
Language: FORTRAN.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATE:
Time Requirements: Compilation Time: 240 seconds; Typical run time: approximately 8 hours.*

*Overall run time is highly dependent on the size of the IRST sensor in terms of detector count and number of samples taken during the scan of the total FOV. This run time is for a detector count of 35 and 140 samples per scan.

Users:

AFEWC/SAM
ASD/ENSSS
ASD/XRHD
ASDI
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Boeing Advanced Systems
Boeing Aerospace
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
ECAC
General Dynamics/Convair Division
Georgia Institute of Technology
Mitre Corporation
NASA Lewis Research Center
Naval Weapons Center
Northrop Defense Systems Division
OptiMetrics, Inc.
Rockwell International/NAAO
SAIC
Sverdrup Technology Inc./TSG
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
United Technologies

TITLE: FIRST FORAY (Revised Edition).

DATE IMPLEMENTED: 1989.

MODEL TYPE: Training (with limited development uses).

PROPONENT: Headquarters Land Force Command, New Zealand.

POINT OF CONTACT: LTC R.J.K. Hoskin, (09) 461-466, Ext. 857.

PURPOSE: FIRST FORAY is currently a manual command post exercise driver. It will be redesigned as a computer-assisted simulation to support the training and development of essentially light infantry battalion and brigade-level forces in low-level or low-intensity conflicts, particularly in tropical environments.

DESCRIPTION:

Domain: Land with some air and maritime aspects.

Span: Local.

Environment: Two-dimensional terrain boards of 1:5.000 or 1:10,000 scale. Specially enhanced designs are available. Weather, light, and other environmental factors are included.

Force Composition: Any joint, combined, integrated, or national force including guerilla, irregular, or dissident forces. Detailed data on New Zealand operational and a specific opposing force has been developed (TOES). A computer version (FORD) has also been completed.

Scope of Conflict: Essentially light infantry operations in medium- to low-level conflict in a tropical environment. This includes supporting operations (artillery, engineers, air, etc.) and civil and paramilitary participation.

Mission Area: Low-intensity conflicts.

Level of Detail of Processes and Entities: Resolutions are generally at the section (squad) level and individual crew-served weapon system. Provision exists for detailed results at individual level if required for personnel and logistic purposes. Suppression, ammunition usage effects, etc., are included. Outcome is not necessarily casualty driven. Includes provision for patrolling, ambushing, sniping, infiltration, improvised explosive devices, civil disorder, and (through control measures) participation by police and other civil organizations. Conflict resolutions are based on a modified firepower score, Monte Carlo-based system.

CONSTRUCTION:

Human Participation: Extensive human participation is required.

Time Processing: Five-minute resolution periods.

Treatment of Randomness: Monte Carlo.

Sidedness: Two-sided or more, depending on scenario.

LIMITATIONS: Manpower-intensive. Present manual form is detailed and tiresome.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Undergoing total revision that will result in a computer-assisted version.

INPUT: Any detailed scenario and force organization.

OUTPUT: Tactical information at the appropriate level including personnel and logistic detail.

HARDWARE AND SOFTWARE:
Computer: N/A.
Storage: N/A.
Peripherals: N/A.
Language: N/A.
Documentation: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: Dependent on data available.

Data Output Analysis: N/A.

Frequency of Use: Approximately five battalion and two to three brigade command post exercises per year.

Users: Land Force Command.

Comments: Not yet sufficiently developed for substantive comment.

TITLE: FLAPS - Force Level Automated Planning System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: HQ U.S. Air Forces Europe/Operations Analysis (DOA), APO AE 09633-5001.

POINT OF CONTACT: Mr. Thomas Yium, DSN 480-6911.

PURPOSE: FLAPS automatically performs daily theater force planning functions for tactical air forces and quickly builds and optimizes air tactical operations plans with respect to limited assets. FLAPS is designed as a decision aid to support operations for developing courses of action as well as daily resource planning. It has been used in an exercise.

DESCRIPTION:

Domain: Air and land.

Span: Theater and regional.

Environment: Radar visibility obstructed by terrain. Bad weather represented by restricted operation zones. Models night and day operations.

Force Composition: One-sided; BLUE air against RED surface threats.

Scope of Conflict: Conventional.

Mission Area: Air-to-ground; close air support and offensive air support (interdiction/strike) refueling, and limited electronic combat for defense suppression.

Level of Detail of Processes and Entities: Entities: Bookkeeping down to individual target and individual aircraft (although not by tail number). Bookkeeping of munitions (by individual round) and fuel (by gallon). Optimization of flight path routing according to discrete state space with interval between points variable but usually a few kilometers. Target damage based upon mathematical probability, but no physical weapons effects calculated. Processes: Movement of aircraft, expenditure of fuel and munitions.

CONSTRUCTION:

Human Participation: Required for decisions. FLAPS waits for a decision.

Time Processing: Planning portion (called ATOGEN), event-step; display portion (called FLAPS), time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Electronic combat.

PLANNED IMPROVEMENTS AND MODIFICATIONS: User-friendliness to be improved in next model release.

INPUT: Subsampled DTED level I terrain, World Data Bank II maps, IMOM electronic order of battle, aircraft types, characteristics, BLUE air bases and force locations/arrivals, RED target locations, munitions types and stockpiles, conventional weaponeering effects.

OUTPUT: Printout of air tasking order displaying mission TOT, unit, quantity of aircraft in mission, target, ordnance load, alternative missions examined, reasons alternatives not selected. Interactive video color map shows flight routes, targets, refueling points.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with VMS operating system. Also runs on Siemens 7-580 mainframe.
Storage:	50-MB, on-line disk.
Peripherals:	Minimum requirements: 1 printer, 1 Tektronix 4125 graphics terminal (alternately Siemens 9732 CAD workstation), 1 VT-220 alphanumeric terminal.
Language:	FORTRAN 77, DCL.
Documentation:	User's manual and data base description document.

SECURITY CLASSIFICATION: Software unclassified, but data bases are classified.

GENERAL DATA:

Data Base: Initial population of data base can take several man-months; however, system designed for receiving data base updates from automatic sources.

CPU time per Cycle: As much as half an hour for several hundred missions.

Data Output Analysis: None.

Frequency of Use: Varies by use. Several times daily in exercises. Several times a year in analyses.

Users: HQ USAFE/DOA/DOO, ATOCH Sembach, Warrior Preparation Center, HQ PACAF/DOA, Joint Intelligence Center of the Pacific, USCINCPAC/J55.

Comments: Managed by HQ USAFE/DOO. Central Europe scenario mature, Asian scenarios partially developed.

TITLE: ILRTRJ - Flare Trajectory Program.

DATE IMPLEMENTED: 1984.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The Flare Trajectory program (FLRTRJ) is a computer simulation which calculates the trajectory of a single flare dispensed from an aircraft. The model produces a time history of the flare position relative to both the aircraft and a fixed point on the earth.

The model is used to selectively vary flare and dispenser characteristics and scenario parameters to determine their effect on the trajectory of the flare.

DESCRIPTION: The basic function of the FLRTRJ program is to model the trajectory of a single flare dispensed from an aircraft. The main program reads the inputs and performs data conversions. It then ejects a single flare from a dispenser and determines the flare's initial position and velocity in the inertial reference frame. It then determines the dynamics of the flare using a second-order Runge-Kutta method to integrate the equations of motion of the flare. The functional form of the coefficient of drag versus Mach Number is based on data found in the Airborne Interceptor Air-to-Air Missile (AI/AAM) engagement simulation. This coefficient is used in the computation of total drag. Atmospheric effects are modeled in the program using standard atmosphere parameters for the pressure and speed of sound at the engagement altitude. A time history of the flare position relative to both the aircraft and a fixed point on the earth is returned to the main program for output.

The model assumes the aircraft is flying straight and level (no maneuver) and dispenses only one flare from the center of mass of the aircraft. The program uses the U.S. Standard atmosphere parameters for the temperature rate, surface temperature and pressure, and a constant stratospheric temperature.

INPUT: Inputs to the model include flare dispenser characteristics such as flare ejection speed and ejection angles; flare characteristics, including flare drag area, shell weight, fluid weight, delay to start of burn, and burn time; and aircraft scenario parameters, such as altitude and speed.

FLRTRJ accepts input data interactively or from input data files. If data files are used, an input file must be written prior to execution. The input data file is in card format and can be provided from a disk file.

OUTPUT: Program output consists of a summary of program input, followed by a time history of the flare position (feet, meters) relative to both the aircraft, and a fixed point on the earth.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	13,131 bytes.
Language:	FORTRAN.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATE:

Time Requirements: Compilation time: 8.72 seconds; Typical run time: 1.22 seconds.

Users: BDM Corporation; Hughes Radar Systems; SAIC.

TITLE: FOF - Follow On Forces Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Training and education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: SFC Don Evans, (49) 631-536-6159, DSN 489-6507.

PURPOSE: FOF is an exercise driver used primarily for training by NATO battle staffs to exercise command, control, and communications procedures. It simulates the movement of rear-area units towards the battle fronts. It also permits attrition and time delays from enemy forces.

DESCRIPTION:
Domain: Land.

Span: Accommodates any theater depending on the data base used; current data bases include Central and Southern Europe and Turkey.

Environment: FOF is defined by a series of nodes that are linked together. Each node has a latitude and longitude location. The nodes represent a transportation network, typically consisting of roads or railways.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional rear-area interdiction.

Mission Area: Air interdiction.

Level of Detail of Processes and Entities: Entities can be units from companies up to divisions, depending on the scope of the exercise. Units can only be effected by damage and player input processes. The damage process can cause attrition to and delay units; the player input process can delay or reroute units as required.

CONSTRUCTION:
Human Participation: Not required; the model is interruptable at any time for player input.

Time Processing: Dynamic, time-step. FOF processes each cycle according to the battle time of the exercise. The time between cycles depends on the data base used.

Treatment of Randomness: Stochastic; Monte Carlo generation of delay and attrition values.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Maximum of 2000 units and 700 nodes can me modeled. Weather and geography are not factors in this model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present time.

INPUT: Size input files must be present before the model can be run. They describe units, subunits, nodes, links between nodes, targets, and directed routes tha' may be specified for a unit.

OUTPUT: Produces printouts of movement, delays, attrition, and disposition of units after they reach their final destination. If desired, units can be displayed on graphics terminals.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	Executable program requires 4,000 blocks plus 15,600 blocks for the global section data base.
Peripherals:	Minimum requirements: one terminal and one printer.
Language:	FORTRAN.
Documentation:	One manual describing model operating procedures and data base build requirements.

SECURITY CLASSIFICATION: Unclassified, but data bases are typically classified.

GENERAL DATA:

Data Base: One man-week required to build a normal data base.

CPU time per Cycle: Depends on data base size and player configuration. A one-hour cycle takes a few minutes of CPU time to process.

Data Output Analysis: Accomplished manually; an analysis file is created each cycle and is reviewed by analysis personnel.

Frequency of Use: Used several times per year.

Users: All NATO forces.

Comments: FOF can be run in conjunction with the WPC AWSIMS model, which simulates air combat, or with the WPC GRWSIMS model, which simulates ground combat. If GRWSIM is being run, FOF must be operated on the same computer.

TITLE: FORCEM - Force Evaluation Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Dr. R. Johnson, (DSN) 295-1593 or (301) 295-1593.

PURPOSE: The model provides simulation of airland activities in a theater of operations over an extended period (up to 90 days). Combat operations are at the division level and most of the combat support and combat service support functions from the port to FLOT are represented. It is a fully computerized simulation for application in studies and analyses of force planning and resource allocation issues. The model is part of a three level hierarchy of Army simulation models (at Battalion, Division/Corps and Theater) developed under the Army Model Improvement Program.

DESCRIPTION:

Domain: Land and air.

Span: Theater campaign. Current data bases are Central Europe, and Southwest Asia.

Environment: Terrain square of selectable size (5-30km). Eight terrain types, including urban and water areas, affecting movement. Day and night difference for some operations. No weather. Road, rail and water transport represented as networks.

Force Composition: Joint and combined forces. Blue and Red. Blue force partitioned into two components for resource accounting purposes.

Scope of Conflict: Primarily conventional. Chemical module operational and nuclear module under development.

Mission Area: Theater ground operations with fire support (including air) and combat service support, including medical, maintenance, supply, and transportation functions.

Level of Detail of Processes and Entities: The level of resolution of combat units is the division. Combat support and combat service support operations are represented by a single support command at each division, corps, army group, and theater representing all combat service support activities. Functional submodels represent the major activities of target acquisition, communications, command and control, division engagement, fire support, air operations, unit movement and combat service support. As an average value simulation, without player interaction, command and control is represented by automated decision processes at three levels in the theater (Corps, Army Group, Theater). Assessment of division battle is made through an analytic representation of a division engagement with sets of attrition coefficients calibrated to the results of engagements simulated by an independent division model. Air operations are represented by groups of aircraft, by mission (eight possible), in an air sector (roughly Corp or Army) or, in a few cases, theaterwide. Area air defense is considered at the same air sector level.

CONSTRUCTION:

Human Participation: Model is interruptable, mostly for purposes of command and control to change unit boundaries and phase lines or air role apportionment factors. Scheduled changes also allowed.

Time Processing: Dynamic, time-step model with 12-hour time cycle.

Treatment of Randomness: Deterministic, without randomness in the model. Some inputs are expected values generated from stochastic processes.

Sidedness: Two-sided, generally symmetric. Command and control input data may be varied by national component on each side to represent different decision factors. Fire support allocation is different between Blue and Red.

LIMITATIONS: No naval operations, weather, engineer functions, EW or rear area combat. Highly aggregated intelligence and communications.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Presently revising nuclear/chemical representation and command and control and engagement process for asymmetric representation of Blue and Red operations and for better representation of breakthrough and reserve and second echelon force employment. Upgrades to intelligence/target acquisition and addition of engineer functions planned.

INPUT:

- In-theater force-units and their assets.
- Arrival schedule-units and assets.
- Theater scenario and plans.
- Terrain.
- Engagement results from division level simulation.
- Weapons and equipment characteristics.
- C^2 decision criteria.
- Performance factors for surveillance, communications, repair, medical, transport, etc., functions.

OUTPUT:

- Computer reports, giving status, losses, and expenditures of units and assets over time.
- Computer graphics graphs and map displays.
- Hardcopy plots and charts.

HARDWARE AND SOFTWARE:

Computer(OS):	UNISYS 1100/84, SUN 4/260.
Storage:	One to three million decimal words, depending on scenario.
Peripherals:	Disk storage, demand CRT terminal, computer graphics terminal and plotter for input and output preparation, tape unit for checkpoint/restart capability.
Language:	SIMSCRIPT II.5.
Documentation:	FORCEM Input Data, October 1990; FORCEM Output Reports, May 1989. Formal documentation not yet published.

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:

Data Base: Three to six months required to build new data base from scratch.

CPU time per Cycle: Depends on scenario. Average of 15-20 minutes per 12-hour cycle.

Data Output Analysis: Highly variable, depending on study. Large volume of output is reduced, combined and manipulated by a postprocessor information retrieval system (UNISYS MAPPER).

Frequency of Use: Four per year for major studies.

Users: Used only at the U.S. Army Concepts Analysis Agency.

Comments: Model operates in hierarchial mode and is dependent on results from higher resolution division model (presently COSAGE) for combat attrition and munitions expenditures.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: FORCOST - Force Costing Model.

DATE IMPLEMENTED: 1979

MODEL TYPE: Training and education.

PROPONENT: War Gaming and Simulation Center, Institute for National Strategic Studies, National Defense University (NDU-NSS-WGSC), Ft. McNair, Washington, DC 20319-6000.

POINT OF CONTACT: R. D. Wright, (202) 475-1251, AV 335-1251.

PURPOSE: To calculate ten year profiles for obligational authority, outlay, and military personnel requirements from a specified 17 year defense program. The model helps users meet fiscal guidance while inflicting minimal damage to force capability or to calculate the cost of an adequate force. Off-line discussions and assessments of risk are an essential part of the use of this model.

DESCRIPTION: The data base contains 100 elements with estimates (where appropriate) for investment: remaining RDTE; fixed line-warm production cost and variable item procurement cost; and full share "ownership": annual operations and military personnel funding including support and training slices. Users specify force structure (divisions, ships, squadrons with active/reserve mix), and the pace of modernization (armored vehicle buys and new generation aircraft), and sustainability investment, for the 17 years. They specify the level of operations maintenance, readiness funding, and major RDT&E program support for ten years. The model does not provide measures of military capability.

Domain: Four services and DOD-wide programs and the Department of Energy weapons program.

Span: N/A.

Environment: N/A

Force Composition: N/A

Scope of Conflict: N/A

Mission Area: N/A

Level of Detail of Processes and Entities: Investment and operations costs for division, separate brigades, and like-size army support elements: MEFs/MEBs, individual ships, squadrons, and wings. Investment costs for major equipment items (like aircraft) assigned to operating units.

CONSTRUCTION:

Human Participation: Seventeen-year defense plan specification, assessment of force capability and strategy-force capability mismatch.

Time Processing: Ten annual steps.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: No model generated measures of force capability. No measures of how O&M funding levels affect readiness.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Menu-driven screen capability.

INPUT: Force units to be deployed each year, major equipment items reaching the force each year, munitions and sustainability stocks to be fielded for seventeen years, annual levels of O&M funding, and schedules for major RDT&E activities for ten years.

OUTPUT: Ten year's annual obligational authority, outlay and active and reserve military personnel.

HARDWARE AND SOFTWARE:

Computer: A-Z-248 or IBM AT or clone with 640K memory,VAX.
Storage: 1 Megabyte hard disk.
Peripherals: Printer.
Language: FORTRAN.
Documentation: FORCOST Databook and User's Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use. Two multi-team exercises per year.

Users: NDU Industrial College of the Armed Forces, National War College.

Comments: Source code maintained at NDU-NSS-WGSC.

TITLE: FORECASTS System II - Future Options Research Executive for the Computer Analysis of Scenario Tracing and Simulations.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Strategic Plans and Policy Directorate (J-5), The Joint Staff, The Pentagon, Rm 2E949, Washington, DC 20318-8000.

POINT OF CONTACT: Dr. Mark Archer, (703) 693-5900.

PURPOSE: FORECASTS is used primarily to analyze, forecast, plan and provide decision support capabilities for long range (out 20 years and beyond) strategic planning. The integrated world model contains military, demographic, political, economic, financial, social and resource sub-models to project future world and regional conditions.

DESCRIPTION:
Domain: Strategic assessments and military planning.

Span: Global and regional.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Plans and policy.

Level of Detail of Processes and Entities: Countries and regions.

CONSTRUCTION:
Human Participation: Required for scenario development and analysis of outputs.

Time Processing: Time-step. Progresses through user defined scenarios with annual time-steps.

Treatment of Randomness: Deterministically based on model rules.

Sidedness: N/A.

LIMITATIONS: Most comprehensive treatment of economic and trade issues, less comprehensive treatment of military capabilities and political conditions. Requires trained analyst for scenario development

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved military capabilities and technology transfer sub-models and enhanced data base management capabilities.

INPUT: Scenario parameters and historical data.

OUTPUT: Graphics based output charts and maps of forecasted values of model parameters.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a SUN microcomputer with UNIX operating system.
Storage:	Minimum 8MB free memory and 90MB available disk storage.
Peripherals:	One printer.
Language:	C and FORTRAN.

Documentation: Complete system documentation and user's manual available.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:
Data Base: Large data base of historical (40 variables) and projected (over two hundred variables) data.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: J-5 Strategy Division, Naval Postgraduate School, U.S. Army Intelligence and Threat Analysis Command.

Comments: None.

TITLE: FRAM - Fleet Requirement Analysis Model.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: Naval Surface Warfare Center, Code N13, 1091 New Hampshire Avenue, Silver Spring, MD 20903-5000.

POINT OF CONTACT: Grant R. Edwards, (301) 394-2739; Michael McPherson, (301) 394-1235.

PURPOSE: FRAM was developed as a tool to analyze the effectiveness of U.S. naval surface combatants in potential threat scenarios and to evaluate improvements in fleet capability due to improvements in combat systems. It can be used to evaluate improvements to individual ships as well as ships within a force context.

DESCRIPTION: FRAM is a Monte Carlo model which time-steps through an input scenario and predicts U.S. fleet response and effectiveness to an enemy air, surface, subsurface attack. Analytical sensor models, envelope, and Pk data are used to predict major combat system performance. Inter-ship data links are modeled together with various coordination algorithms among assets.

Domain: Area and point defense of naval assets. (AAW).

Span: Regional or local conflicts. Many-on-many to one-on-one.

Environment: Any environment, providing sensor and weapon data are available for type of environment one wishes to run.

Force Composition: Red forces against Blue forces with Blue response. (Individual ships to complete fleet battle groups.)

Scope of Conflict: Conventional weapons.

Mission Area: Anti-Air Warfare (AAW).

Level of Detail of Processes and Entities: Each ship, ASM, or bomber is modelled as an individual platform. Cookie cutter for some processes, detailed for combat systems and weapon scheduling.

CONSTRUCTION:

Human Participation: None.

Time Processing: Variable time-step, inputted by user.

Treatment of Randomness: Monte Carlo, different processors can have different seeds and random number selection.

Sidedness: N/A.

LIMITATIONS: AAW model only. Due to virtual memory computers not limited in the number of platforms, sensors, and weapons.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Plans include converting the model to ADMRALS model with most warfare areas included.

INPUT: Scenario input describing the ship and threat launching platforms (Blue and Red fleet composition and disposition, sensor, launcher, weapon, magazine and illuminator composition per Blue platform; ASM launch rate and targeting, degree of coordination desired and jamming parameters). Block Data

(Blue force sensor, weapon, and launcher characteristics; ASM characteristics and flight profiles; Pk data).

OUTPUT: Computer printouts. Narrative event listing (ASM firings; engagements scheduled; outcome of engagements; Hits on Blue fleet). Postprocessor results (time ordered events of engagement scheduled with parameters and results). Statistics (Total number and type ASM killed; magazine status; ASM hits per ship).

HARDWARE AND SOFTWARE:

Computer:	CDC Cyber computers, Vax and micro Vax, IBM AT and compatibles, SUN workstations. (Almost any computer that has FORTRAN V or FORTRAN 77 compiler.)
Storage:	Vax 16 megs, IBM at 640K.
Peripherals:	1 printer.
Language:	FORTRAN V or FORTRAN 77.
Documentation:	Partial.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: One to several days depending on size of scenarios.

CPU time per Cycle: Depends on computer speed and number of platforms inputted; as long as 30 sec to 15 min.

Data Output Analysis: Raw output data can be very large, there is a postprocessor used to reduce the output. Also ORACLE data base can be used for graphical output.

Frequency of Use: Used for several studies a year.

Users: NAVSWC, SPAWAR 30, NAVSEA 06.

Comments: Very useful portable model for regional and force studies in the AAW area.

TITLE: Frequency Hopping Model (including cosite variation).

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds, ATTN: [STEEP-(T-E)], Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Mr. Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: The Frequency Hopping Model is an operational support tool (decision aid) used to assist in conducting compatibility and vulnerability analysis of frequency hopping communications and electronic equipment and systems in tactical deployments. The output is used to determine if systems are suitable for deployment. EMC/EMV analyses of the SINCGARS frequency hopping radio have been performed.

DESCRIPTION:
Domain: Land, air, and limited space and naval.

Span: Accommodates any theater depending on data base. Can model individual equipment to full corps and above deployments.

Environment: Detailed RF phenomenology model. Models the effect of terrain and ground constraints in either an area prediction or point-to-point mode. DMA digitized terrain data can be used as input. Effects of time of day, month, and climatology considered for various propagation models.

Force Composition: Joint and combined, BLUE, GREY, and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: Model uses deployment data concerning the location, terrain, and required linking of C-E equipment contained in a tactical force to calculate the communicability, compatibility and vulnerability of the C-E systems. This model samples a required number of links and based upon equipment technical performance characteristics and propagation losses initially determines the probability of communication (compatibility) over a link without interference. The model then computes the propagation loss for each possible interferer and computes a desired versus interferer signal ratio. The model then computes the probability of correct information transfer (compatibility), using previously measured performance data (scoring) for each particular piece of C-E equipment. The effects of jamming (vulnerability) on each link are similarly calculated by substituting the jammer as the interferer. ESM functions of intercept and DF are also modeled. For DF, the model can produce both a numerical probability of DF and an associated DEP value.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Can be run in either a deterministic or a probablistic mode. Monte Carlo options are available for estimations of propagation variables from the mean.

Sidedness: Not applicable.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Propagation modules are under study for enhancement plus computer graphical development for file updates, data validation, and model output presentations.

INPUT: Tactical deployment data, equipment technical performance characteristics, and propagation path loss parameters.

OUTPUT: Printout of probability of C-E equipment/systems communicability, compatibility, and vulnerability performance in their intended tactical operational environment.

HARDWARE AND SOFTWARE:

Computer:	CYBER 180 Model 830.
Storage:	Variable; requirements can be adjusted.
Peripherals:	Optimum number of disk and tape drives varies; variable mass storage requirements in size of data files determine requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires one year. Analysis requiring data modification for specific test system requires one to two months depending on system.

CPU time per Cycle: Depends on deployment size and number of equipment to be evaluated. Corps-size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts and data files suitable for statistical postprocessing.

Frequency of Use: One to six analyses performed per year.

Users: Model is resident at USAEPG. Numerous analysis have been performed for a variety of government agencies.

Comments: The model is not machine dependent. It does, however, take advantage of the CDC CYBER 60-bit word for optimizations of data storage and access, and would require modification for other environments.

TITLE: FROBAK - Front End-Back End.

DATE IMPLEMENTED: 1986.

MODEL TYPE: AEM Analysis model Pre- and Postprocessor.

PROPONENT: Air Force Center for Studies & Analysis, Rm 1D376, The Pentagon, Washington, DC 20301.

POINT OF CONTACT: LCDR Barrowman, (703) 697-8546, AV 227-8546.

PURPOSE: FROBAK is a series of five modules (Prober, DGZer, DAGGER, DEVAL, POSTAL) developed to expand the AEM allocation model into a process that allows for the treatment of detailed target data, defense modeling, and operational constraints.

DESCRIPTION:

Domain: Ground- and sea-based strategic offensive and limited ground-based defense systems.

Span: Single-sided (but sequential) worldwide strategic force application analysis.

Environment: Ground- and sea-based.

Force Composition: RED offensive missile threat and BLUE ground strategic defense system (or vice versa).

Scope of Conflict: Strategic offensive nuclear and defensive exchange analysis.

Mission Area: Strategic nuclear conflict.

Level of Detail of Processes and Entities: AEM target and weapon data bases are aggregated up to 400 target classes and 50 weapon classes. The front-end (FRO) automates the processing of target installation data bases and builds and aggregates aimpoints/DGZs, producing an AEM-ready target input deck. The back-end (BAK) postprocesses a resultant AEM allocation, assigning warheads to carriers at launch points, and re-evaluates the damage at the individual target installation level.

CONSTRUCTION:

Human Participation: Analyst identifies the aggregation and descriptive guidelines for aggregation of installations. Program is almost always run in batch mode.

Time Processing: Thirty minutes for DGZing; less for other modules.

Treatment of Randomness: N/A.

Sidedness: One-sided.

LIMITATIONS: The five modules of FROBAK are only loosely related into a consistent user interface.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Automated DEVAL computations over time and missile range and footprint feasibility control and reporting.

INPUT: Target Base: file location of objective installations. Defense files: defense files location. Weapons files: weapons lat/long and number of weapons at each site.

OUTPUT: AEM target class file input files to AEM; DGZ file: lat/long locations; strike files.

HARDWARE AND SOFTWARE:

Computer: VAX 11/780 or better.
Storage: Minimal; largest file required is usually the objective installation file.
Peripherals: None required; terminal or line printer for report review.
Language: FORTRAN.
Documentation: User's Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Supported by user-generated flat files.

CPU time per Cycle: Typical run times are less than 30 minutes.

Data Output Analysis: In form of line printer reports.

Frequency of Use: Weekly to quarterly.

Users: AF Studies & Analysis, The Joint Staff/J-8 NFAD, and many others.

Comments: None.

TITLE: FSTAM - Force Structure Trade-Off Analysis Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Engineer School.

POINT OF CONTACT: Charles Herring, (217) 373-7260.

PURPOSE: FSTAM is a testbed model used to provide a low resolution combined arms simulation that represents combat engineers at the level of detail needed by analysts at the U.S. Army Engineer School, to experiment with engineer force structure representations, to determine measures of effectiveness for engineer contributions to the combined arms battle, to prototype for exercise driver, and to explore the feasibility of running full-scale simulations in a personal computer environment.

DESCRIPTION:
Domain: Land and air.

Span: Theater or regional.

Environment: Hex-based model. Scale determined by data set. Four types of terrain, five levels of roads, four levels of rivers, day and night operations, weather, minefields, point obstacles, antitank ditches, blown bridges, military bridges, and survivability positions modeled.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional warfare with limited nuclear and chemical.

Mission Area: Conventional, combined arms teams. Includes eight types of engineer teams for mobility, countermobility, and survivability tasks.

Level of Detail of Processes and Entities: Maneuver units of any size; engineer teams; variable resolution determined by input.

CONSTRUCTION:
Human Participation: Required for decision, but model continues to run without a decision.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic; land attrition computed by firepower score method.

Sidedness: Two-sided, symmetric. Can be run by single operator or with gamers for BLUE and RED.

LIMITATIONS: 175 units total.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of logistics and user interface improvement.

INPUT: Two modules support input: MAPMAKER for interactive map building and EDITDATA for data base input.

OUTPUT: Produces screen reports and printouts of movement, attrition intelligence, and engineer activities.

HARDWARE AND SOFTWARE:

Computer: IBM-AT or better with math coprocessor.
Storage: 2 MB of RAM.
Peripherals: EGA and monochrome monitor.
Language: FORTRAN 77. Lahey EM/16.
Documentation: User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Depends on scope; can be as little as one person-week.

CPU time per Cycle: Depends on data.

Data Output Analysis: Produces hardcopies of raw data.

Frequency of Use: Varies.

Users: U.S. Army Engineer School.

Comments: N/A.

TITLE: G2WS - G2 Workstation.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Training and education.

PROPONENT: Commander, ATSI-TDN-W, U.S. Army Intelligence Center and Ft. Huachuca, Ft Huachuca, AZ 85613-6000.

POINT OF CONTACT: MAJ Gary W. Allen, (602) 533-3364, AV 821-3364.

PURPOSE: G2WS is a simulation that provides for individual and team skills development and can also be used as the driver for a Command Post Exercise. The simulation's primary purpose is to train intelligence professionals from the corps level down to Military Intelligence Battalion in the doctrinal use of information and intelligence. The G2WS is also used to test new intelligence doctrine developed at the Intelligence Center.

DESCRIPTION:

Domain: Land, air, space, sea.

Span: Theater.

Environment: Portrays digital terrain data to include elevation, natural and cultural terrain features.

Force Composition: From Joint down to element of Blue and Red forces.

Scope of Conflict: Conventional, unconventional, nuclear, chemical, and rear area.

Mission Area: All Battlefield Operating Systems.

Level of Detail of Processes and Entities: The G2WS is a high fidelity exercise. The lowest entity portrayed is a single soldier or weapon system. The processes that effect these elements include movement and attrition.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic (time dependent).

Treatment of Randomness: G2WS uses a number of sub-models that employ stochastic (direct computation) and deterministic techniques.

Sidedness: Two-sided (asymmetric, both sides reactive).

LIMITATIONS: The number of elements represented per side is limited to 1000.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of new scenarios to reflect areas of interest.

INPUT: Terrain data, weapons characteristics, communication net structures, non-communication emitters, and units.

OUTPUT: Intelligence reports (printout) based upon the placement and tasking of the intelligence assets.

HARDWARE AND SOFTWARE:

Computer(OS): VAX 11/785, 5 MicroVAXes running VMS.
Storage: 400 MBytes.
Peripherals: 20 VT220 terminals, 4 Tektronix Graphics Terminals, 10 desk printers, 1 line printer, 2 multiplexers, ethernet.
Language: PASCAL.
Documentation: Available through proponent.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: 60-90 days.

CPU time per Cycle: 1:1.

Data Output Analysis: N/A.

Frequency of Use: On average 2 weeks/month.

Users: Used by the Military Intelligence Officers Advanced Course, Advanced Non-commissioned Officers Course, active and reserve component units.

Comments: The G2WS is a hybrid of the Janus force-on-force model developed by Lawrence Livermore Labs and intelligence collection models designed by personnel at the Intelligence Center. This combination provides a highly interactive simulation that portrays potential combat environments.

TITLE: GAMM - Generalized Air Mobility Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Directorate of Advanced Systems Analysis, DCS for Development Planning, Aeronautical Systems Division (ASD/XRM), U.S. Air Force, Wright Patterson Air Force Base, OH, 45433-6503.

POINT OF CONTACT: Steven J. Wourms, DSN 785-6261, Commercial (513) 255-6261.

PURPOSE: GAMM simulates the activities of a theater airlift system. GAMM is a research and evaluation tool, and was developed as a primary analytic force capability and requirements tool for the study of future theater airlift systems. The model deals with both airlifter fleet mix and operational effectiveness of the theater airlift system both in part and as a whole. Although not a combat model, GAMM gives static measures, from extremely detailed to extremely aggregated, of the airlift system's effectiveness in moving cargo.

DESCRIPTION

Domain: Cargo is moved by a combination of air and land.

Span: Theater or regional.

Environment: Airbases in relatively great detail, both established and opportune; temperature and pressure/altitude effects on airlifter performance; cargo transshipment by truck and/or helicopter.

Force Composition: BLUE cargo-carrying air and ground vehicles.

Scope of Conflict: All attrition treated using random draws, parameters for which are generated externally to GAMM.

Mission Area: Theater (a.k.a. intratheater and tactical) airlift.

Level of Detail of Processes and Entities: Entities: Airlifters are modeled by individual tail number, and each piece of cargo in the system is individually tracked. Processes: 1) Transshipment, characterized by time to move cargo and by a probability of survival; 2) Airlifter maintenance, battle damage repair, and servicing--each an individual random process; 3) Cargo handling is characterized as a random process with mean time to load and mean time to unload; 4) Airlifter attrition and battle damage, both in the air and on the ground, are derived randomly.

CONSTRUCTION:

Human Participation: Not required, though the model is interruptable for user alterations.

Time Processing: Dynamic, event-step driven.

Treatment of Randomness: Stochastic (Monte Carlo).

Sidedness: One-sided, although effect of airlifter attrition and battle damage by RED forces is treated through random processes.

LIMITATIONS: Treatment of airlifter operations on unsurfaced soils.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Nothing significant at this time.

INPUT: 1) Jobs file, which describes each piece of cargo to be moved during the simulation. Cargo is described by all dimensions, priority, and entry and delivery sites and times. 2) Scenario file, which describes all airfields; entry/delivery site information; and the airlifters' performance, turn, and survivability characteristics, and homebasing assignments.

OUTPUT: Several computer output products available, from highly detailed to highly aggregated. Model can be run interactively, with graphics screens showing airlifter movements across theater.

HARDWARE AND SOFTWARE:

Computer (OS):	VAX/VMS. UNIX version has been attempted, but simulation software compiler is replete with errors, and unable to handle programs of this size.
Storage:	Basic software and input files require roughly 50MB. Much more space required for analytic production work.
Peripherals:	Monochrome character cell terminal is sufficient to run model. Much more is required, graphically, for analysis work.
Language:	SIMSCRIPT II.5.
Documentation:	Programmer/Analyst's Manual, 1989, and User's Manual, 1989.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Requires from one man week to one man year to assemble, depending upon level of complexity and availability of information.

CPU time per Cycle: Requires 10 minutes on a MicroVAX II for one replication of our 1987 Southwest Asia scenario.

Data Output Analysis: Varies with level of detail desired.

Frequency of Use: Averages several times per week at ASD/XRM.

Users: Include several Government and industry organizations.

Comments: None.

TITLE: GEMM - Generic Missile Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE Analysis.

PROPONENT:

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: GEMM is a mathematical representation of an airborne missile attacking a penetrating vehicle. The missile may be a surface-to-air, air-to-air, or air-to-surface missile. The missile simulation includes missile dynamics, weight, thrust, aerodynamics, guidance, and control systems. Each penetrator can be maneuvering in six-degrees-of-freedom and posses its own cross-section (IR or RF) table.

The model is a time-based model which integrates the missile and target equations of motion for initiation of the simulation up to the termination. The model generates a time history of any variable which the user selects. In addition, summary information is produced for each run.

DESCRIPTION: The GEMM model can simulate up to twenty targets. The missile can be given any initial conditions and almost any type of weight-thrust-guidance combination.

The GEMM model is a moderately fast running model, depending on the missile performance and target location. The minimum distance that the missile approaches to the target is the main measure of effectiveness for each missile simulated.

The objective in developing the GEMM model was to provide a methodology by which the analyst could: 1) Perform parametric studies of missile performance values to examine design constraints, and 2) Study effects of countermeasures on missile performance.

Additional applications are 1) Determine launch envelopes for a particular target/missile combination, and 2) Study effects of variable cross-section data.

GEMM has the capability to model: 1) Air-to-Air, surface-to-air, and air-to-surface missiles; 2) Single or multiple targets; 3) Maneuvering targets; 4) Command, homing, or command-to-homing guidance.

Each missile system can incorporate any of the following options:
- Rocket, ramjet, or combination rocket/ramjet.
- Statistical or calculated track errors.
- Optical or radar seeker.
- Proportional, pursuit, or deviated pursuit homing guidance.
- Lateral error, climb cruise, or derivative + proportional + integral for command guidance.
- First or second order lag system.

The calculated track errors include:

- Multipath.
- Thermal noise.
- Clutter.
- Range errors.
- Glint.
- Scintillation.
- Instrumentation errors.
- Jamming (onboard and standoff jammers).
- Chaff.
- Terrain bounce.
- Cross-eye.
- Radome errors.

GEMM has the capability of running replications of a deck, if necessary, with the only change being the random number seed, or the user can also change any input set. This could, for example, allow a user to run the same launch position of a target with several missile launch angles.

The GEMM model does not require any input from other models. The inputs for GEMM are generated using intelligence information for foreign threats, contractor information for U.S. threats, and engineering judgment for those inputs which are not available.

The outputs from GEMM are utilized to assist in determining the intercept envelopes for the Simulation of Penetrators Encountering Extensive Defenses (SPEED). The orientation information at closest approach from GEMM can be input into BETA to determine a probability of kill which can also be utilized by SPEED.

<u>INPUT</u>: The inputs are supplied by the user in a card image file. Only those inputs for the specific system being modeled are input. For example, if a system has a rocket motor, then no ramjet information is input and, in fact, the card images in this case for the ramjet are omitted.

<u>OUTPUT</u>: The major portion of the output is a time history of user-selected variables. The user has the option of selecting from a list of over 200 variables to be printed as a function of time. In addition, a list of all the input parameters is echoed back to the user as part of the output. A list of each initialized subroutine is produced during the initiation phase. This can be helpful in error tracing. A summary of the simulation is the final portion of the output. This consists of an indication of the reason for termination. The following events will cause termination: Minimum distance achieved; Loss lock; Ground clobber; and Self-destruct.

<u>HARDWARE AND SOFTWARE</u>:

<u>Computer</u>: VAX 11/780.
<u>Storage</u>: 274,000 bytes.
<u>Language</u>: FORTRAN IV.
<u>Documentation</u>: Tracking Radar Algorithms, User's Manual, Input Guide, Common Blocks Cross-Reference List, Description and Operation of the Generic Missile Model.

<u>SECURITY CLASSIFICATION</u>: Source Code is Unclassified.

<u>GENERAL DATE</u>:

<u>Time Requirements</u>: Compilation Time: 14 minutes (with linking); Typical run time: A typical case of a typical SAM for a 40 Km launch from the target utilities takes 41 CPU minutes to run five replications on a VAX 11/780 system.

Users:

513 TESTS/TEOE.
AFEWC/SAX.
BDM Corporation
Booz, Allen & Hamilton
E-Systems, Greenville Division
FTD/SDAEW
GTE Government Systems Corporation
Hughes Radar Systems
LTV Aerospace
Loral Advanced Projects
Mitre Corporation
Naval Weapons Center
Northrop Corporation - Aircraft Division
SAIC Sanders Associates, Inc.
Survice Engineering Corporation
Sverdrup Technology Inc./TEAS
The Rand Corporation
Tracor Aerospace, Inc.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: GEMMTLCM - GEneric Missile Model with Tracking Loops and Counter-Measure.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC), 700 Franklin Road, Suite 200, Marietta, GA 30067.

POINT OF CONTACT: Mark D. Bond, SAIC, (404) 426-9359.

PURPOSE: The purpose of GEMMTLCM is to aid the missile systems analyst in the study of missile guidance and control against low observable (LO) aircraft. The secondary purpose of the model is to generate end-game geometry templates that can be mapped into probabilities of kill to feed higher order campaign-level models.

DESCRIPTION:

Domain: Land and sea.

Span: One aircraft on one missile system.

Environment: An associated off-line program builds a mask file from Defense Mapping Agency (DMA) terrain elevation data for use in target masking and clutter calculations.

Force Composition: Single element BLUE vs. RED or RED vs. BLUE.

Scope of Conflict: Accommodates any type of RF and IR, command and homing guided, surface-to-air, and air-to-air missile system.

Mission Area: Single penetrator with jammer against a single missile system.

Level of Detail of Processes and Entities: Lowest radar entity modeled is a radar subsystem: transmitter, pulse doppler or MTI circuit, noncoherent integrator, gain control. Pulse doppler and MTI processing limited to single spectral return in user-defined filter. Target fluctuation models limited to Swerling 1-4, Chi-squared, Weinstock, and nonfluctuating. Clutter reflectivity data from Lincoln Labs; limited to 9 types of land form and 5 types of land cover to form 45 combinations of land state. Lowest missile control system modeled is guidance control algorithm.

CONSTRUCTION:

Human Participation: Not required or permitted.

Time Processing: Dynamic, closed form solution. Output is end game geometry.

Treatment of Randomness: Deterministic; random noise sums to the mean (deterministic) over an integration period.

Sidedness: Symmetric.

LIMITATIONS: Does not model angle, range, or doppler tracking. Target fluctuation limited to Swerling models 1-4, Chi-Squared, Weinstock, or nonfluctuating.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Moving target detector (MTD: MTI followed by pulse doppler) will be added. Integration period algorithms for coherent jamming will be designed.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	GEMMTLCM executable = 200,000 bytes. Input files = 100,000 bytes each (including antenna patterns). Mask files = 65,000 each (1 deg x 1 deg). Terrain executable = 30,000 bytes. TERMSK executable = 23,000 bytes. ALARMSS terrain elevation data files = 500,000 each (1 deg x 1 deg). DMA terrain elevation data files = 1,500,000 bytes each (1 deg x 1 deg). Associated menu driver and utilities executable = 50,000 bytes.
Peripherals:	No peripheral support required for operation. A graphics display terminal to view templates is recommended.
Language:	FORTRAN.
Documentation:	A user's manual and input guide are available.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base construction time is minimal provided that preparation is performed by a qualified radar analyst and aerodynamic engineer.

CPU time per Cycle: Depends on number of simulation points. An 80-point RF simulation would require approximately 4 CPU hours on a 4-MIP machine.

Data Output Analysis: Depends on level of engineering skills; generally extensive for analytic mode and less for template generation mode.

Frequency of Use: Extensive use by airframers in analysis of LO design.

Users: N/A.

Comments: Configuration is controlled by SAIC under contract to the Electronic Combat Digital Evaluation Systems at Wright-Patterson Air Force Base, Ohio.

TITLE: GENSAW - User-Assisted Generic Systems Analyst Workstation, Version 2.0.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: AAMRL/HE, Wright-Patterson AFB, OH 45433-6503.

POINT OF CONTACT: Dr. Robert G. Mills, (513) 255-7588, AV 785-7588.

PURPOSE: GENSAW is a research and evaluation tool that provides user-assisted analysis techniques for systems R&D. GENSAW is comprised of a variety of systems analysis techniques including a simulation model development capability, SAINT Plus (formerly MicroSAINT). The information below deals only with the SAINT Plus capability.

DESCRIPTION:

Domain: Land, sea, air, space, and undersea.

Span: Global, theater, regional, local, or individual.

Environment: To be defined by the user or users.

Force Composition: To be defined by the user or users.

Scope of Conflict: To be defined by the user or users.

Mission Area: To be defined by the user or users.

Level of Detail of Processes and Entities: SAINT Plus is an event simulation modeling language. The level of detail of processes and entities is defined by the user or users.

CONSTRUCTION:

Human Participation: Required in model construction for decisions and processes. Generally, a model cannot be modified on-line to its execution. A model can be modified within GENSAW off-line to its execution. A model can be interrupted in order to freeze the output display during its execution. Schedule changes are executable within a model. Human participation is permitted during model execution but only if there is a desire to change a predefined variable's value.

Time Processing: Dynamic, event-stepped and closed form.

Treatment of Randomness: A model can be stochastic or deterministic depending upon user's problem and development.

Sidedness: A model can be one-sided or more depending on user's problem and development.

LIMITATIONS: Modeled system complexity and execution time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Currently, SAINT Plus is a modeling capability limited to operator's workload data analysis. Planned improvement is to host GENSAW on a PC capability and expand the SAINT Plus data analysis portion to include a capability beyond operation(s) workload.

INPUT: Depend on a given model's development. Generally the input will include operator's task parameters as well as scenario, environment, and physical (e.g., aircraft aerodynamics) parameters.

OUTPUT: Computer printouts, plots, raw data, and statistically analyzed data.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a MicroVAX II with Micro VMS 4.5 or greater and GKS 3.0.
Storage:	3639 blocks (1.9 MB) needed before GENSAW data bases are created.
Peripherals:	VR-260 terminal.
Language:	FORTRAN.
Documentation:	Technical documentation is available; there are no DDC accession numbers.

SECURITY CLASSIFICATION: Unclassified without a given problem structure, parameters, or data. SAINT Plus is an unclassified computer simulations language.

GENERAL DATA:

Data Base: Preparation time depends upon user's problem. GENSAW provides automatic SAINT Plus code generation.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: GENSAW Version 2.0 has recently become available for field application. Aside from AAMRL, there are currently no other users.

Comments: N/A.

TITLE: GIAC - Graphic Input Aggregate Control.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: Geri Lentz, (49) 631-536-6507, DSN 489-6507.

PURPOSE: GIAC is intended to provide a graphical input/output ability for the WPC's Distributed Wargaming System.

DESCRIPTION: GIAC provides the user with a graphical view of the simulation and allows for the input of orders through a graphics menu system. GIAC allows for both local and remote data transfer over a networked communications system. GIAC also allows for aggregate control by allowing the user to send orders to groups of units graphically selected.

CONSTRUCTION:
Human Participation: Required.

LIMITATIONS: As of 1991 GIAC does not graphically display digitized maps.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Develop interfaces for the Army's Corps Battle Simulation, the WPC's NAWSIM model, and the Joint Theater Level Simulation, enhance networking capabilities, interface with additional work-station platforms, and develop graphical displays of digitized maps.

HARDWARE AND SOFTWARE:
Computer: UNIX or VMS workstation platforms (SUN, DEC5000, 3100, VAX3100 and X-Terminals).
Language: C using X window graphics protocols.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Users: Warrior Preparation Center.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: GPM - Generic Phase Meter.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill High, ITT Avionics, (201) 284-2870.

PURPOSE: For analysis of ECM vs. Phase Meter receivers.

DESCRIPTION: The Generic Phase Meter receiver and proposed ECM are modeled using the CSMP modeling program. Spectral images are created via an embedded FFT algorithm.

INPUT: ECM model using CSMP building blocks.

OUTPUT: Printout/plots of analog signals at desired points within the receiver, including frequency domain.

HARDWARE AND SOFTWARE:
Computer: DEC VAX.
Storage: 75K Bytes; memory requirements: 4M Bytes.
Language: FORTRAN 77 (VAX).
Documentation: None. Documented sample cases.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Typical data: 5 minutes.

CPU time per Cycle: 5 minutes on VAX computer.

Usage: IR&D analysis for Techniques Research.

Comments: Generated plots may be viewed using the HPLT general plot program on a VAXstation supporting UIS graphics.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: GRAFIC.

DATE IMPLEMENTED: 1989.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543, (513) 255-4429.

PURPOSE: GRAFIC allows the Suppressor user to easily produce displays of player's paths, lay downs, control zones, fire ranges, and contour maps modeled in a Suppressor simulation. One graphic display can show all players in a scenario or a user-designated subset. The scale of each graph is determined by the user, allowing for any degree of resolution.

DESCRIPTION: GRAFIC graphically displays information as modeled in a Suppressor simulation. Displayed information may include player locations, paths, control zones, fire ranges, and contour maps. Since the graphs are intended to aid Suppressor users in preparing and analyzing simulations, all plots represent true data used during a simulation and no artificial smoothing or rounding of lines takes place. Data is extracted from the Scenario Data Base (SDB) or the MODEL (MOD) binary files. If terrain is present, then the Environment Data Base (EDB) is also read. The only user input needed identifies what information is to be displayed.

INPUT: The input to GRAFIC consists of the language files, an SDB or MOD binary file, possibly an EDB file, and a GRAFIC data file. The GRAFIC data file contains a sequence of plot requests, each being executed in the order they appear. The user may make separate plots on top of each other using the same scale or different scales for each plot.

OUTPUT: GRAFIC output consists of three plots. The first contains two contours: a planned XY path and line-of-site ranges. The second plot is of the planned altitude path, and the third is a plot of the planned time path.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780.
- Storage: 1,152,000 bytes.
- Language: FORTRAN 77, GK-2000.
- Documentation: User's Manual.

SECURITY CLASSIFICATION: Source code is Unclassified.

GENERAL DATE:
Time Requirements: Compilation time: 3 to 5 minutes; Typical run time: 83.2 seconds.*

* Varies significantly depending on the number of players, if terrain is used, and number of paths plotted.

Users: SAIC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: Groundwars.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Material Systems Analysis Activity; Attn: AMXSY-GC, Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: Mr. Thomas Ruth, AV 298-2924, Commercial (301) 278-2924.

PURPOSE: Groundwars is primarily used to evaluate weapon system effectiveness. The model can address ammunition expenditures, acquisition, delivery accuracy, vulnerability, lethality, rate of fire, disengagement policies, effect of line-of-sight due to terrain or obscurants, and the effect of various round types (e.g., KE, HEAT, command-to-line-of-sight, fir and forget, or near simultaneous-engagement type missiles).

DESCRIPTION:

Domain: Land combat between homogeneous forces.

Span: Accommodates any regional area depending on data base.

Environment: The model is limited to a total of 20 combatants, including fighting systems and decoys. Methodology incorporated includes near-simultaneous fire-and-forget missiles, artillery, multi-target acquisition (attacker groups), line-of-sight enhancements and the ability for tanks to jockey during the engagement process.

Force Composition: Blue and Red homogeneous forces.

Scope of Conflict: Conventional Warfare.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Attrition for ground systems are probability of kill, Monte Carlo based, and output single system kills.

CONSTRUCTION:

Human Participation: None.

Time Processing: Dynamic, event-stepped model.

Treatment of Randomness: Stochastic employing Monte Carlo probability theory as its primary solution technique.

Sidedness: Two-sided, symmetric model.

LIMITATIONS: Groundwars simulates only homogeneous forces on each side. The total number of combatants, attacker and defender combined, cannot exceed twenty.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Heterogenous forces as well as multi-weapon per platform are changes currently planned.

INPUT: None.

OUTPUT: Enhance output with the aid of graphics.

HARDWARE AND SOFTWARE:

Computer:	Gould 9080, VAX-11/780, Cray X-MP, Cray-2, FHX Alliant or 386 PC.
Storage:	200K.
Peripherals:	None.
Language:	FORTRAN 77.
Documentation:	AMSAA Technical Report 478 "Groundwars 4.0 User's Guide," dated October 1989.

SECURITY CLASSIFICATION: Unclassified, but data bases are classified.

CONTROL DATA:

Data Base: Scenario dependent - approximately 2 weeks. Creation of Input files: two days - one week. To analyze output: one day - one week.

CPU time per Cycle: Gould 9080: 20-25 minutes per 300 replications. FHX Alliant: 45 minutes per 300 replications. Cray's: 3-5 minutes per 300 replications.

Data Output Analysis: Produces hardcopies.

Frequency of Use: Continuous.

Users: USAMSAA, U.S. Army Missile Command, U.S. Army Armor School, Kaman Science Corporation, Rockwell International, U.S. Army Tank Automotive Command, U.S. Natick Research Development and Engineering Center, General Dynamics Land System Division, and Surviac operated by Booz, Allen & Hamilton, Inc.

TITLE: GRWSIM - Ground Warfare Simulation.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and Education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: TSPG (SFC. Don Evans), (49) 631-536-6159, DSN 489-6507

PURPOSE: GRWSIM is used at the WPC as an exercise driver to train NATO commanders and their battle staffs in real-world combat decision making.

DESCRIPTION:

Domain: Land and air.

Span: Any theater depending on data base. Extensive WPC use in Central and Northern Europe.

Environment: Hex-based with 3.2 km hexes. Each hex described by one of seven discrete terrain types and a set of transportation barrier values for each side. Day and night operations and limited constant weather modeled.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Primarily conventional warfare; limited nuclear and chemical effects.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Unit is lowest entity modeled. Unit size and composition are data base build inputs and should be compatible with hex size and exercise objectives. Ground units usually modeled at company level. Attack helicopters dynamically spawned as a unit from larger units as needed and can attack specific weapon systems within an entity. Direct combat attrition evaluated on single entities. Attack helicopter attrition evaluated on individual helicopters.

CONSTRUCTION:

Human Participation: Required for decisions and processes, but model will continue to run without player input.

Time Processing: Dynamic, time-step. Geared towards real-time operations.

Treatment of Randomness: Deterministic ground direct combat attrition based on Lanchester equations. Other attrition and random events based on probability tables with Monte Carlo determination of results.

Sidedness: Two-sided, symmetric, reactive.

LIMITATIONS: Needs VAX global section capability. There is limited weather and intelligence collection; limited chemical, nuclear, engineer, and 20,000 unit data base (maintained as an indexed sequential file).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Develop and implement a data base building system that will enhance data integrity, consistency and security.

INPUT: Companion programs control exercise. Program FIRST used by players to build initial data base. Ground I/O programs: Remote GIO and Graphical Input Aggregate Control allow players to interface with the simulation during the exercise.

OUTPUT: Printouts of all player transactions and relevant events grouped by major subordinate commands. Companion graphics programs can derive SUN or VAX workstations 500 graphics hardware. Battle damage data written to flat files to support INGRES data base analysis.

HARDWARE AND SOFTWARE:

Computer:	Designed for a VAX computer with a VMS operating system.
Storage:	52,000 blocks (26MB) required for data base installation.
Peripherals:	Depends on exercise requirements. One VT 100 terminal required for execution. Player output can be stored on disk or automatically sent to a line printer. Companion programs have additional peripheral requirements.
Language:	VAX FORTRAN 77.
Documentation:	In-house programmer reference documentation; extensive published user documentation.

SECURITY CLASSIFICATION: Unclassified, but if classified data base is used, model generates classified data.

GENERAL DATA:

Data Base: Several man-months for initial population of large data bases and several man-days for updating a data base for a particular exercise.

CPU time per Cycle: Depends on data base size, player configuration, and computer capability; typically 2 to 5 minutes of CPU to process 1 cycle of 20 game minutes.

Data Output Analysis: Periodic data extraction performed outside of GRWSIM. Snapshots of data base are taken for backup and restart capability and can be used for post-game analysis. Certain data are captured explicitly for analysis.

Frequency of Use: Depends on WPC exercise schedule. Typically used in six to seven major exercises per year.

Users: NATO commanders and their battle staffs.

TITLE: GT-SIG - Georgia Technology - Signature Prediction Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Georgia Technological Research Institute (GTRI), Atlanta, GA.

WORK SPONSORED BY: CECOM Center for Night Vision and Electro-Optics
Attn: AMSEL-RD-NV-VMD-TST, Ft. Belvoir, VA 22060-5677.

POINT OF CONTACT: Khang Bui, C2NVEO, DSN 354-4074; COMM (703) 664-4074.

PURPOSE: To predict thermal backgrounds and to predict temperature distribution of air and ground vehicles (validated for Ft. A.P. Hill, VA). C2NVEO uses GT-SIG in its three dimensional synthetic scene generation.

DESCRIPTION:

Domain: Background features (trees, grass, and soils); ground and air targets.

Span: Accommodates several different spectral bands (e.g., 3-5 and 8-12 micron) for its predictions. It is able to use weather data from various geographical areas.

Environment: Code is developed for specific machines (e.g., there is to be a Silicon Graphics version). Currently, GT-SIG is executed on a VAX 11/780 computer. Models diurnal cycles of background and target features.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Three-dimensional synthetic thermal scene modeling.

Level of Detail of Processes and Entities: A. Target/Feature File Construction: Precise composition and orientation of feature data is required to accurately thermally model a ground surface area and target. Targets are composed of different numbers of facets depending on the range. Resolution is a primary consideration in the choice of target selection. B. Execution of GT-SIG Model: Setup for execution of GT-SIG requires accurate and detailed meteorological information. Scenario descriptions must be known to provide information concerning latitude and longitude of test site.

CONSTRUCTION:

Human Participation: Required for Processes.

Time Processing: Dynamic, time- and event-stepped model. Progresses through set number of diurnal cycle intervals that have been user defined.

Treatment of Randomness: GT-SIG is basically a determinstic model.

Sidedness: N/A.

LIMITATIONS: Background features are simplistic.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Plan to improve ease of model input. Model to be transferred to the Silicon Graphics Workstation.

INPUT: Target files. Meteorological files.

OUTPUT: Table of temperatures of features, where feature is a facet, or a background element, such as tree, rock, etc.

HARDWARE AND SOFTWARE:
Computer(OS): VMS operating system, Operating on VAX.
Storage: Hard disk required.
Peripherals: Laser Printer.
Language: Believed to be Fortran 77.
Documentation: Available from GTRI.

SECURITY CLASSIFICATION: Unclassified, but restricted distribution to licensees for the source code of GT-SIG. Target files may be classified.

GENERAL DATA:
Data Base: 24 hours of meteorological data required for meaningful model execution.

CPU time per Cycle: Depends on the complexity of target facetization and the length of the thermal cycle duration.

Data output Analysis: Tabular thermal file of predictions is created with mean and standard deviation.

TITLE: GUNFIRE - Air-to-Air Gun Program.

DATE IMPLEMENTED: 1982.

MODEL TYPE Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The purpose of GUNFIRE is to provide a simple, fast-running model to determine the effectiveness of rapid-fire air-to-air guns (AAGs), used against missiles and other aircraft. It can also be used for rapid-fire surface-to-air guns.

DESCRIPTION: The GUNFIRE model is used to determine the probability of a hit by a single shell, the probability of at least one hit by a stream of shells, and the expected number of hits by a stream of shells in an air-to-air engagement. It does so by determining the chance of a hit per shell for a radially inbound or outbound target, then degrading this value to allow for errors that become important with an increasing transverse velocity component for the target.

The GUNFIRE model includes several assumptions about the nature of the engagements. Some of these are inherent in the approach; others are simplifying assumptions adopted for this realization of the model. The principle assumptions are as follows:

Gun is aimed at target (no "sweeps" or strafing).

Gun fire control system estimates where the target will be at shell arrival time and aims shells to arrive on a continuous basis.

Shells are scattered around the aimpoint in a flat or circular Gaussian fashion.

The aimpoint may be offset from the target's true position by errors related to azimuth/elevation tracking and small gun and/or target perturbations. These errors are random (i.e., not bias), and, for purposes of hit probability, these errors are equivalent to gun dispersion errors.

The aimpoint may be offset from the target's true position by errors related to the target's transverse velocity and gun-sensor offset. These errors are random (i.e., not bias), and, for purposes of hit probability, these errors are equivalent to gun dispersion errors.

Shell hit probabilities are independent (all models); that is, cumulative probability for shell "i" can be expressed as:
Pcum(i) = 1 (1-Phit(i))*(i-Pcum(I)).

Hit probability can be characterized by a lognormal curve.

All tracking and dispersion errors are independent.

Shells have constant flyout velocity (all models).

Target area is constant (all models).

Gross motion for the duration of the engagement can be characterized by constant cartesian acceleration (all models).

Shell flyout time and shell arrival range can be calculated using constant velocity assumptions for gun platform and target.

INPUT: The position, velocity, and acceleration vectors of the target and the gun platform are user specified. Other user inputs include the target cross section, gun parameters (rate of fire, dispersion, shell flyout velocity, etc.), and tracking/fire control parameters (tracking Az/El/Range errors, control loop delay, etc.). Program input can either be supplied interactively, or can be stored in NAMELIST format in a file.

OUTPUT: The basic GUNFIRE output consists of a summary at the terminal of the time, the gun and target position, the probability of hit per shell, the probability of at least one hit from shells fired in the current increment, and the accumulated hit probability up to the current increment.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780.
- Storage: 25,126 bytes.
- Language: FORTRAN 77.
- Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATE:
Time Requirements: Compilation time: 22.07 seconds; Typical run time: 0.52 seconds.

Users:

BDM Corporation
SAIC
Survice Engineering Corporation

TITLE: HAREM - Hughes Anti-armor Requirements and Effectiveness Model.

DATE IMPLEMENTED: From 1987 to present.

MODEL TYPE: Analysis.

PROPONENT: Hughes Aircraft Company, Missile Systems Group, Mission Analysis Lab.

POINT OF CONTACT: Chan McKearn, 5J-03, CP 262 C27, (818) 702-4594.

PURPOSE: HAREM is a Land Combat model developed to perform operational effectiveness analyses in a combined arms setting. It may be used for engineering trade-off analyses, determining weapon system requirements, and cost/operational effectiveness analyses for particular systems or mixes corresponding to proposed courses of action or planned force structures.

DESCRIPTION:

Domain: Land and air.

Span: HAREM can accommodate any theater, given the appropriate digitized terrain data base; data bases currently employed are Iran; Hunfeld, Germany; Turkey; and Kuwait.

Environment: Combined arms, ground-to-ground, air-to-ground, and ground-to-air in all weather, day or night, under dirty battlefield conditions. One hundred meter digitized terrain for intervisibility. Terrain is divided into 5 categories for resolving speed/mobility issues.

Force Composition: Up to 30 types of vehicles with 3 weapons per vehicle type. Model is completely two-sided and the 30 vehicle types can be divided between RED and BLUE as desired. Up to 1000 players can be represented.

Scope of Conflict: The normal defensive scenario represents a U.S. battalion defending against an attacking Motorized Rifle Regiment or Tank Regiment. A typical attack scenario represents a U.S. Brigade attacking a Soviet battalion or regiment.

Mission Area: The model is normally used for requirements analyses or Cost and Operational Effectiveness Analyses (COEA) for ground systems and helicopters. The effects of close air support, artillery, and mines are also represented.

Level of Detail of Processes and Entities: HAREM simulates the air/land battle at all levels, from a single vehicle to regimental level. Tactics are controlled by order streams. These order streams contain directives issued to groups of vehicles (e.g., platoons, companies, etc.); however, actual movement, searching, firing, attrition, changing speed, making smoke, hiding, communication, etc., are carried out by individual vehicles. Vehicle tactics may be reactive, that is their actions may depend on the actions of other vehicles or groups of vehicles. For example, one unit may hold in place until another unit reaches a certain objective. Units are also sensitive to the number of casualties they have received (e.g., they may stop attacking and start to withdraw if they receive 50% casualties).

CONSTRUCTION:

Human Participation: Human participation is currently not permitted once the simulation starts.

Time Processing: Dynamic, event-driven model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric, both sides reactive.

LIMITATIONS: Chemical or Nuclear weapons are not represented.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Identification Friend or Foe (IFF) between ground players and air-to-ground engagements is being developed. Reactive artillery orders which will permit forward observers to dynamically generate fire missions is being created. All artillery missions are currently scheduled *a priori*.

INPUT: Inputs include descriptions of vehicles (physical size; speed and altitude for various terrain conditions and tactics; number of weapons and sensors on board; number of rounds of each type stored on board; time required to replenish the basic load of ammunition), weapon characteristics (minimum and maximum ranges; hit and kill probabilities; rate of fire; firing doctrine; guided or not guided; coordinated or uncoordinated; reliability; reload times), sensor characteristics (probabilities of detection and recognition for each target type as a function of range, target exposure, and target motion; vertical and horizontal fields-of-view), tactics, firing doctrine, flight profiles, command and control net, and terrain.

OUTPUT: Detailed summary statistics include average number of shots by weapon type, distribution of shots by range, average number and standard deviation of kills by type for entire simulation, average number of killed vehicles by type on each side, loss exchange ratio, system exchange ratio, killer/victim scoreboard, status of each individual vehicle, performance data for each weapon system type, vehicle type, sensor/station combination.

HARDWARE AND SOFTWARE:

Computer:	VAX 8800 mainframe computer, VMS operating system.
Storage:	Minimum input data storage requirement of 6500 blocks, minimum output data requirement of 5000 blocks.
Peripherals:	High-speed laser printer to accommodate large input and output listings, Macintosh computer for pre- and postprocessors.
Language:	FORTRAN 77.
Documentation:	User's Manual, Version 2.0 - July 1991. Pre-processor User's Manual, Version 2.4 - April 1989. Concept and Model Description, Version 1.0 - April 1989. Flow Charts, Version 1.0 - April 1989. Source Code Listing. Training Materials. Briefing Materials.

SECURITY CLASSIFICATION: Model itself is unclassified, but input data is often proprietary and classified.

GENERAL DATA:

Data Base: Minimum time required to prepare inputs, including terrain data base, order streams, hit-kill and detection-recognition probabilities for a new scenario is 2 weeks. Creation of order streams is facilitated by pre-processor. Changing parameters (e.g., weapon range or probability of kill values) to conduct parametric runs only takes a few minutes.

CPU time per Cycle: Total CPU time is dependent upon number of vehicles played, number of replications, amount of artillery, size of terrain box, whether or not Directed Energy Weapons (DEW) are involved, and whether or not obscurants are played. For a simulation involving 8[illegible] vehicles, one replication may take one and one half to two and one half hours of CPU time. Smaller scenarios with only 30 players on one side and 60 on the opposing side take only four or five minutes for one replication.

Data Output Analysis: Reports and detailed summary statistics provide sufficient information for analysis. Postprocessor allows analyst to select all or subsets of vehicles and event types to be played back visually on the screen of a Macintosh II computer. This visual display of the battle speeds up the analysis process and provides many insights which might otherwise be overlooked.

Frequency of Use: This model is used continuously by Hughes Aircraft Company

Users: Mission Analysis Lab to conduct studies. Several studies are listed below:

Infantry Anti-Armor Weapon System Study.
The Directed Energy Weapons Options Study.
Unmanned Aerial Vehicle Study.
Armored Family of Vehicles.
AAWS-M White Paper and RFP Support.
JAGUAR Parametric Analysis.
UAV Close Requirements Analysis.
UAV Survivability Study.
Helicopter Air to Air Study.
Fiber Optic Guided TOW (FOTOW).
Non-Line-of-Sight Support.

Comments: None.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: HAVDEM - Helicopter Air-to-air Value-Driven Engagement Model.

DATE IMPLEMENTED: 1992.

MODEL TYPE: Analysis.

PROPONENT: Aviation Applied Technology Directorate (AATD), U.S. Army Aviation Systems Command, ATTN: SAVRT-TY-CD, Fort Eustis, VA 23604-5577.

POINT OF CONTACT: Mr. Jimmy I. Anderson, (804) 878-0103.

PURPOSE: HAVDEM is an engagement-level air-to-air combat simulation used primarily for the evaluation of helicopter airframes, avionics, weapons, and tactics.

DESCRIPTION:

Domain: Air-to-air (also simplistic ground-to-air).

Span: Engagement level.

Environment: Digital terrain; user-selected constant radar reflectivity, IR earth and sky background, optical visibility; sun position; cloud layers.

Force Composition: Individual blue and red units; surface-to-air (SAM) sites.

Scope of Conflict: Conventional warfare.

Mission Area: Air-to-air helicopter combat and waypoint following.

Level of Detail of Processes and Entities: Individual helicopter with specific avionics configurations and weapon loadouts; detailed missile flyout; generic models for each avionics device type with differences instantiated through data, SAM sites containing up to 6 SAMs. Helicopter (6-DOF aerodynamics flyout), Missile (4-DOF no roll, detailed seeker representation with explicit guidance), Fixed guns; Probability of detection algorithms for optical, Infra-red, and radar sensors; sophisticated simulation of pilot decisions utilizing value-driven decision algorithms and an information-oriented architecture; pilot decisions utilize terrain features.

CONSTRUCTION:

Human Participation: None.

Time Processing: Dynamic, Event-Step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric, both sides reactive.

LIMITATIONS: No explicit cultural terrain features; Runtime penalty with increasing number of players like n^2; Default limits: 20 helicopters, 10 missiles per helicopter, 2 missile types per helicopter - modifiable; Uses any 10km x 10km region ARTBASS terrain data base, not compatible with DMA terrain data bases.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Air-to-ground capability; Graphical Display Improvements Front End (X-Window based graphical front end for scenario preparation, graphical display of input data, etc.); Cooperative behavior among helicopters; DMA compatibility.

INPUT: Terrain map, helicopter configurations, initial positions, and initial avionics status; data base of aircraft, avionics, and weapon characteristics.

OUTPUT: Summary file of important events. User-controlled diagnostic output file. Summary file for graphical replay of engagements from view of remote observer and/or from cockpit view.

HARDWARE AND SOFTWARE:

Computer(OS):	Recommend UNIX machine (MIPS, SUN, Silicon Graphics, etc.) because of availability of a UNIX-based environment for configuration control and concurrent multiple study isolation.
Storage:	Recommend several hundred megabytes for source, object, data, and outputs.
Peripherals:	Printer, graphics terminal.
Language:	FORTRAN 77 and several C routines.
Documentation:	Management Summary, User's Manual, Analyst's Manual, Programmer's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: If using existing terrain, weapons, avionics, and airframe data bases, preparation consists of waypoint specification and layout of initial flight configurations and positions - generally about a day for engagement with 4 helicopters on each side but depends upon the complexity of the terrain and waypoint itinerary.

CPU time per Cycle: Depends upon number of helicopters in engagement, engagement duration, and computer speed. For an engagement of 3 vs. 3 helicopters, the faster UNIX workstations (MIPS, SUN, Silicon Graphics) will run in real time.

Data Output Analysis: As Monte Carlo simulation, requires at least 20-30 iterations per fixed condition. User-supplied statistical postprocessor required. Graphical review of all iterations recommended.

Frequency of Use: AATD study scheduled in 1992.

Users: AATD.

Comments: HAVDEM is the result of a Small Business Innovative Research (SBIR) Phase II program that has been accepted by the Army for Phase III continuation.

TITLE: HELIPAC - Helicopter Piloted Air Combat Model.

DATE IMPLEMENTED: September 1990.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-484..

PURPOSE: HELIPAC is used primarily to assist in the evaluation of rotary-wing and fixed-wing aircraft, armaments, and tactics by simulating the performance of aircraft and weapons in combat.

DESCRIPTION:
Domain: Air.

Span: Mission.

Environment: Terrain relief.

Force Composition: Opposing flights of aircraft.

Scope of Conflict: Conventional weapons.

Mission Area: Counterair.

Level of Detail of Processes and Entities: The following entities are modeled: rotor aerodynamic performance limits, engine installed power, body decoupled from flight path, pitch, yaw, and roll dynamics, observables, and vulnerability. Engagement simulations include helicopter agility, helicopter tactics, and turret guns.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-stepped.

Treatment of Randomness: Stochastic, detection based on Monte Carlo trial.

Sidedness: HELIPAC is a two-sided asymmetric model in which both sides are reactive.

LIMITATIONS: HELIPAC has limited sensor simulation capability. The probability of detection approach does not account for all clutter and background effects in nap-of-Earth flight.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: HELIPAC accepts initial scenario information, number of helicopters and fixed wing aircraft, types of helicopters, helicopter performance, weapon number and type, weapon performance, weapons release conditions, tactics, and detection contours.

OUTPUT: HELIPAC produces a narrative output and helicopter versus enemy aircraft flight path history.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780, PC.
Storage:	3.6 MB.
Peripherals:	N/A.
Language:	FORTRAN 77.
Documentation:	HELIPAC User's Manual, HELIPAC Analyst Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained form SURVIAC.

TITLE: HELSCAM - Helicopter Scenario Assessment Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Directorate of Land Aviation/Project Management Office Canadian Force Light Helicopter, National Defence Headquarters, Ottawa, Ontario K1A OK2, Canada.

POINT OF CONTACT: Mr. Andy Boothroyd, (613) 992-8960, AV 842-8960.

PURPOSE: HELSCAM will be used primarily to analyze helicopter characteristics and equipment combinations for light observation, light armed, and attack helicopters in support of the ground commander. In particular, it can examine both weapon systems development and effectiveness as well as combat development doctrine.

DESCRIPTION:
Domain: Army units and helicopters.

Span: Local (up to about 30 weapon systems over an area measuring 20 by 15 kilometers for about 30 minutes of battle time).

Environment: Combination of 100-meter and 12.5-meter digital terrain, and general light level, visibility, and atmospheric extinction.

Force Composition: N/A.

Scope of Conflict: Conventional.

Mission Area: Primarily helicopter operations and the supported and enemy ground units.

Level of Detail of Processes and Entities: Entity: A weapon system, e.g., helicopter, tank, air defense unit, observation point, and armored personnel carrier. Processes: Each unit can move; attain line of sight; and acquire (detect, recognize, and identify), interpret (what, color, damage, and activity), select, engage, communicate, and coordinate movement.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Advance, withdrawal, or halt along fixed paths only; helicopter aerodynamics not played (no helicopter versus helicopter); unit information never incorrect, only incomplete; shoot-look-shoot engagements only; one sensor per unit; and no survivability equipment.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Terrain data files and route planning facility to create and edit unit paths; the rest is in a large data file.

OUTPUT: Event logs are interpreted by graphical replay and analytical facilities.

HARDWARE AND SOFTWARE:

Computer: Simulation core on a VMX computer and facilities on a Packard-Bell PC/AT microcomputer.

Storage: No problem.

Peripherals: None.

Language: Simulation core in VAX FORTRAN 77, route planning and graphical replay facilities in Microsoft "C", and analysis facility in dBase III.

Documentation: In preparation.

SECURITY CLASSIFICATION: Model unclassified.

GENERAL DATA:

Data Base: Two man-months.

CPU time per Cycle: Unknown.

Data Output Analysis: Unknown.

Frequency of Use: Unknown.

Users: Proponents.

Comments: HELSCAM is currently (April 1989) being tested and evaluated by its sponsors.

TITLE: HFPPM - High Frequency Performance Prediction Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: ECAC.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: HFPPM is a research and evaluation tool used to predict the performance of HF nets considering the background signal environment and interfering nets.

DESCRIPTION:

Domain: A large area; e.g., Northeastern U.S.

Span: Regional area.

Environment: Considers time of day and year and sunspot activity.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Communications in a theater.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: Static.

Treatment of Randomness: Stochastic-direct computation.

Sidedness: One-sided.

LIMITATIONS: Nets with 50 stations per net; 2.0 to 30.0 MHz. Background signal data not readily available.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None planned.

INPUT: Net configurations, area of interest, time of day and year and sunspot number.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:

Computer: UNISYS 1182, Exec 8 operating system; VAX with VMS.
Storage: 1 MB.
Peripherals: Printer.
Language: FORTRAN.
Documentation: User's Manual, ECAC-UM-89-053.

SECURITY CLASSIFICATION: Unclassified program, data and results may be classified.

GENERAL DATA:

Data Base: HF communications environment must be developed - uses scenario of communications nets.

CPU time per Cycle: A series of models - each takes 1 to 3 minutes.

Data Output Analysis: Must understand bit error rate computations.

Frequency of Use: Used on ECAC projects only.

Users: ECAC.

Comments: Developed as an in-house capability.

TITLE: HOME - Homing Missile Engagements.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Studies and Analysis Directorate, The Air Force Electronic Warfare Center, ESC, San Antonio, TX 78243-50000.

POINT OF CONTACT: Roland Graves, (512) 925-2391, AV 945-2391. Jimmy Washington, (512) 925-2391, AV 945-2391.

PURPOSE: The HOME model is used to evaluate the effectiveness of infrared (IR) missiles against target aircraft under varying conditions.

DESCRIPTION:

Domain: Land and air.

Span: Individual scenario.

Environment: Assume normal environment conditions.

Force Composition: N/A (a single missile vs. a single target aircraft).

Scope of Conflict: Conventional (RED, BLUE, and GRAY).

Mission Area: Aircraft survivability through countermeasures.

Level of Detail of Processes and Entities: The model calculates the vulnerability of one aircraft to one infrared missile. Processes such as attenuation of target signature, dynamics of missile and target, and effectiveness of countermeasures are involved. Relevant effects of missile components (rather than the components themselves) are simulated.

CONSTRUCTION:

Human Participation: Required for processing (data input).

Time Processing: Dynamic.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Only one target may be used per simulation. Terrain masking effects are not considered. Output quality is dependent upon measured input quality.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Threat, target, and countermeasures data bases. Initial threat and target conditions.

OUTPUT: Vulnerability envelopes, miss distances, and flyout graphics.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS operating system.
Storage:	Two megabytes are needed for the executable code and the data bases.
Peripherals:	Tektronix 4125 series (graphics) terminal and a Tektronix 4692 series color graphics copier.
Language:	FORTRAN 77.

Documentation: User's manuals from original procedures and local directorate.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: The primary source for the parametric data used in all of the data bases is obtained from our unit's electronic combat data library. The library receives its information from national assets as well as from testing facilities.

CPU time per Cycle: Scenario-dependent.

Data Output Analysis: The output analysis is based on missile miss distances that occur close enough to the target to be considered lethal. Flyouts can be simulated from hundreds of different launch points by incrementing range and angle of the threat location as input. Flyouts can be performed against targets with and without IR decoys so that the relative effectiveness of the decoys can be determined.

Frequency of Use: Several times a year depending on tasking requirements.

Users: AFEW/SATC and AFEW/SAX.

Comments: None.

TITLE: ICAN - Integrated Cost and Need.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: ANSER Inc, 1215 Jefferson Davis Highway, Suite 800, Arlington, VA 22202.

POINT OF CONTACT: Mason Washington, (703) 685-3167.

PURPOSE: ICAN develops, maintains, and fosters analytic use of resource allocation and capability assessment models. ICAN models integrate multi-objective needs analysis with program resource analysis. These models serve as a mission capability assessment tool to assess the impact of cost or resource quantity changes.

DESCRIPTION:

Domain: Any domain as specified by the user.

Span: Any span as specified by the user.

Environment: Any environment as specified by the user.

Force Composition: Any force composition as specified by the user.

Scope of Conflict: Any scope of conflict as specified by the user.

Mission Area: Any mission area as specified by the user.

Level of Detail of Processes and Entities: Any level of detail supported as specified by the user. Models are static and discrete time unit driven. The hierarchical organization can accommodate 15 levels with 10 items per level. Appropriate allocation algorithm may need programming. ICAN currently uses a declining marginal returns algorithm. Resources are allocated to the most important objectives where the most important objective is achieved. Once the objective is achieved or resource expanded, the next best resource and objective allocation is addressed. Resource attrition and objective effectiveness are input by user. Model may run for up to 12 time periods.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Five hundred types of objectives maximum allowed for specification in the objectives tree. Two hundred fifty types of resources maximum allowed for resource specifications.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Provide another allocation algorithm that is rule-based. Enhance the resource and cost interface for program cost analysis of resources. Improve report generation function to furnish better graphics and analytic report features.

INPUT: Objectives (names, weights, relationships, and quantities). Resources (names, weights, and relationships). Resource to objective allocation description (resource effectiveness, sorties available, and resource attrition).

OUTPUT: Produces output of model description (tree diagrams, file dumps, etc.). Also produces computer reports or graphical depictions of calculated objective capabilities (summary and per objective). Also shows allocation results during model exemption.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on IBM AT microcomputer with a MS DOS operating system. Transportable to VAX computer with a VMS operating system or UNIX based computer.
Storage:	Minimum of 20 MB hard disk and 640K main memory.
Peripherals:	1 printer.
Language:	"C."
Documentation:	User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of data bases is dependent on the size of the model.

CPU time per Cycle: Dependent on the data size of the model. Large models will usually take less than an hour to run.

Data Output Analysis: N/A.

Frequency of Use: Designed for frequent use of trade-off and sensitivity analysis of resource allocation option.

Users: Currently under final preparation for USSOCOM and SAF/LERD.

Comments: None.

TITLE: ICATS - Interactive Computer-Augmented Training System.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Training and Education.

PROPONENT: TBD.

POINT OF CONTACT: TBD.

PURPOSE: ICATS is used primarily as a tutorial and equipment simulation device for the development of individual or team skills in either a stand-alone or networked configuration. ICATS can be used for both skills development and as an exercise driver.

DESCRIPTION:

Domain: Can be land or an abstract domain.

Span: Can be local or individual.

Environment: Can provide both hardware simulation using physical mockups or software simulation of actual operational equipment using high resolution graphics, animation, video, and sound.

Force Composition: Can simulate individual node operator or a small network of interlinked nodes.

Scope of Conflict: Conventional theater communications.

Mission Area: Tactical mobile ground based communications including Division, Corps and above.

Level of Detail of Processes and Entities: ICATS can model individual communications shelters and communication equipment down to the operation of controls and indicators on individual equipment front panels or the actual access of simulated on-line data bases. A communication link between two nodes can also be simulated along with both normal and faulted conditions.

CONSTRUCTION:

Human Participation: Required for decisions as part of the simulation, but will continue to run without a decision.

Time Processing: Tutorial segments are static. Simulation portion is dynamic with a combination of time dependent and event dependent processes.

Treatment of Randomness: Basically deterministic.

Sidedness: Can be operated by a single operator or, if established as a requirement, can be networked with up to 20 users interacting as interdependent nodes or communication links with one instructor as an orchestrator.

LIMITATIONS: ICATS cannot readily recognize voice transmissions although it can generate canned voice responses to pre-programmed stimuli. Limited to approximately 20 students in a network simulation but no limitation for nonnetworked scenarios.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Further integration of a combination of physical mockup hardware with soft-simulation of hardware planned. Expansion to include pseudo-voice-recognition to enable two-way comm simulation. Expansion to additional operating systems including UNIX and MS-DOS.

INPUT: Operator inputs in the form of point-and-click mouse interface, keyboard inputs, or manipulation of switches on physical mockup equipment.

OUTPUT: High resolution graphical representations of real equipment operations and indicators, digitized sounds, textual or audio tutorial information, or actual operation simulated equipment indicators and lights.

HARDWARE AND SOFTWARE:

Computer(OS):	Macintosh IIci with Macintosh System 6.0.7 operating system. Partial implementation on MS-DOS and UNIX operating systems available.
Storage:	8 Megabytes RAM and 80 Megabytes hard disk storage.
Peripherals:	Optional 13" or 19" high-res color monitor, universal interface controller card, optional operational hardware active mockups.
Language:	C and HyperCard or equivalent for other OS.
Documentation:	Self-documented on-line tutorial system and separate paper-oriented instructor manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Automatically loads at startup within 30 seconds.

CPU time per Cycle: Real time response due to dedicated CPU for each student.

Data Output Analysis: Instructor log printed outputs available showing student progress and performance.

Frequency of Use: Varies by specific implementation. Can be used on a daily basis by continuous student throughput in a school environment or on an as-required basis for refresher training within active or reserve units.

Users: MSE equipment users at MSE Resident School with potential available for use by active and reserve units at unit locations.

Comments: System is in a development growth phase with continued expansion of capability and application. While currently focused as an MSE solution, system capability could be applied to any operational equipment.

TITLE: ICM - Intelligence Collection Model.

DATE IMPLEMENTED: May 1984.

MODEL TYPE: Training and education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof AS, Germany APO NY 09021.

POINT OF CONTACT: TSPG/EW, TSgt Daniel McAfee, 011-631-536-6090, AV 489-6090.

PURPOSE: ICM is an exercise driver that allows the tasking of intelligence collection assets and provides detailed intelligence reports. ICM can be configured for different levels of command post exercises. It is well suited for corps-level and echelons-level play, but can be and is being tailored for division-level play by the BCTP, Ft. Leavenworth, KS.

DESCRIPTION:

Domain: Intelligence collection assets are modeled in the air even if they are characteristically ground sensors because of the restrictions on movement that are imposed by the WPC's ground model.

Span: European theater is the current typical scale.

Environment: The descriptions of the sensors and platforms are mixed with certain sensors and platforms that are able to operate in all weather and in day and night configuration, while others are restricted based on their real-world capability.

Force Composition: Can produce some fused results to describe unit information.

Scope of Conflict: All conventional and unconventional warfare. Can detect all categories of weapons on either side of a conflict and in rear areas.

Mission Area: N/A.

Level of Detail of Processes and Entities: ICM is modeled to collect detail from the type of gun in the soldier's possession to the type of unit including the unit name and parent unit. ICM processes HUMINT, ELINT, COMINT, and IMINT sensor type collection activities.

CONSTRUCTION:

Human Participation: Required to produce any result. The model will run without the human factor but will not produce any results until valid collection orders are issued.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides nonreactive.

LIMITATIONS: Limited by number of units, platforms, and sensors that can be represented in a single data base.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved data fusion and graphics display.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer(CS): Currently being run on VAX machines under VMS operating system.

Storage: Approximately 650 blocks required to load the program.

Peripherals: Output is dumped to printers, TEKTRONICS, and SUNS via other programs.

Language: FORTRAN.

Documentation: Technical handbook and user's guide.

SECURITY CLASSIFICATION: Model is unclassified. Input file classification depends on the sensor data base.

GENERAL DATA:

Data Base: Data base creation time depends on the level of play desired. A permanent collector data base requires approximately three man-months. An exercise data base can be built in approximately one man-month.

CPU time per Cycle: Typically 3 to 5 CPU minutes are required to process one 20-minute cycle.

Data Output Analysis: An intelligence history file that contains all sensors taskings and collection results is maintained.

Frequency of Use: Used for all air and ground exercises at the WPC, which typically involves 10 to 15 major exercises per year.

Users: Players at the WPC and BCTP include NATO commanders and their battle staffs.

Comments: ICM is interlinked with the GRWSIM ground data base, which allows collection against all ground forces to include enemy follow-on forces.

TITLE: IDAHEX - Institute for Defence Analyses Hexagon Model.

DATE IMPLEMENTED: 1985-1986.

MODEL TYPE: Analysis.

PROPONENT: SHAPE Technical Centre, PO Box 174, 2501 CD The Hague, The Netherlands.

POINT OF CONTACT: Dr. U. Candan, Commercial xx-31-70-3142304; IVSN 257-2306.

PURPOSE: The IDAHEX model is a computer program that acts as a bookkeeper and a controller in a two-sided computer assisted, conventional analytical game. IDAHEX emphasizes player "generalship" (skill and style) and the principles of manoeuvre warfare while retaining substantial detail in unit characteristics and combat dynamics. IDAHEX terrain is divided into hexagons which regulate unit movement; units are allowed to attack and move in six directions. The model represents manoeuvre and its consequences including non-continuous FEBAs, breakthroughs and encirclements. The model also is concerned with weapon-on-weapon attrition, supporting fire, offensive air support and air interdiction, engineer activities and logistics. It is specifically designed to assess the sufficiency of force levels and operational concepts.

DESCRIPTION:
Domain: Land, limited offensive air support and air interdiction operations.

Span: Mainly theater or army level application. Several data bases (Central and Southern Regions of ACE) completed, others in preparation.

Environment: Hex based. Several different road and railway types can be represented. Each hex is assigned a terrain type and on each hex side natural or man-made barriers and shoulder space limitations can be represented. Day and night operations may be represented but not implemented in current applications.

Force Composition: Combined forces, Blue and Red.

Scope of Conflict: Primarily conventional land warfare with offensive air support and air interdiction inputs. All conventional land forces' weapons and their effects can be represented.

Mission Area: All conventional land warfare missions.

Level of Detail of Processes and Entities: Generally, Red divisions and Blue brigades/regiments are represented. However, units at any level and size can be represented. Movement or attack/defend/withdraw/delay directives can be issued to ground forces. Ground attrition is calculated by using weapon-on-weapon interactions. Logistics can be modeled at any level of detail. Some engineering activities are represented. A stochastic algorithm is used to model the effects of intelligence operations.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Dynamic, time- and event-stepped model. Execution stops at end cycle (4-6 battle hours) and waits for planner's inputs to continue.

Treatment of Randomness: All processes are deterministic except FEBA movement and intelligence gathering activities.

Sidedness: Two-sided, symmetric.

LIMITATIONS: There are no nuclear or chemical features in the model, representation of air-ground combat is rudimentary and air-air combat is absent.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A major improvement program is started. This improvement program includes graphical interphase, command and control representation, movement of formations and various other enhancements in different parts of the model, found during use to be desirable features. A PC-version is also planned.

INPUT: Ground orders of battle: unit locations; terrain; road, rail and barrier types movement rates; weapon-on-weapon attrition rates; engineer capabilities; supplied consumption rates; and attack and defense styles and postures. Air orders of battle· unit (base) locations, movement (range) limitations, and weapon-on-weapon attrition rates.

OUTPUT: Summarizes important events for the players at their terminals, files a detailed history for retention on tape or high-speed printing.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/8700, VMS.
Storage:	3500K.
Peripherals:	1-3 terminals, high-speed printer, on-line printer.
Language:	FORTRAN 77.
Documentation:	"IDAHEX: A Manoeuvre-Oriented Model of Conventional Land Warfare", STC Publications TM-762 and TM-763.

GENERAL DATA:

Data Base: Preparation - 3 months (to develop data base), 2 weeks (to structure data in model input format). Setup time: 1 day player learning time. Playing time: 6 (for 1 day of combat).

CPU time per Cycle: Two minutes.

Data Output Analysis: 2 weeks.

Frequency of Use: 2-5 major wargames a year on average (no game last year, but extensive use is planned for next year).

Users: SHAPE Technical Centre; OSD (PA&E); Korean Institute of Defense Analysis; Turkish General Staff; Hellenic Armed Forces General Staff; Italian Department of Defense; British Operational Analysis Establishment; UK Army Staff College, Camberley; Allied Forces Southern Europe.

TITLE: IEW - Intelligence/Electronic Warfare Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds,
ATTN: STEEP-(T-E), Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: IEW is an operational support tool (decision aid). It is used to evaluate the capability of proposed IEW systems, to receive and process specified levels of message traffic, and to evaluate the performance of sensor systems.

DESCRIPTION:
Domain: Land, and air, and limited space and naval.

Span: Accommodates any theater depending on data base. Can model individual equipment to full corps and above deployments.

Environment: Detailed RF phenomenology model. Models the effect of terrain and ground constraints in either an area prediction or a point-to-point mode. Options available to use DMA digitized terrain data as input. Model considers effects of time of day, month, and climatology for various propagation models.

Force Composition: Joint and combined, BLUE, GREY, and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: IEW uses deployment data concerning the location, terrain, and required linking of communications and electronics equipment contained in a tactical force. The operation of intelligence sensors is simulated. The model represents the physics of signal transmission, interception of signals by sensors, and direction finding by multiple sensors.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, event-driven simulation containing some closed-form representations of processes.

Treatment of Randomness: Can be run in either a deterministic or a probabilistic mode. Monte Carlo options are available for estimations of propagation variables from the mean and in the selection of the interference environment that is "on" at specific times in the scenarios.

Sidedness: N/A.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Propagation modules are under study for enhancement plus computer graphical development for file updates, data validation, and model output presentations.

INPUT: Tactical deployment data, equipment technical performance characteristics, propagation path loss parameters, message traffic data. Sensor technical data includes timing and setup parameters.

OUTPUT: Model outputs consist of the tactical reports issued by the sensors during the simulation. Sensor-reported information includes time of the report, time of the intercept, detected target characteristics, and perceived target location. Ground truth data is available to compare perceived versus actual battlefield information.

HARDWARE AND SOFTWARE:

Computer:	CYBER 180 Model 830.
Storage:	Variable; requirements can be adjusted.
Peripherals:	Optimum number of disk and tape drives varies; variable mass storage requirements in size of data files determine requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires one year. Analysis requiring data modification for specific test system requires one to two months, depending on system.

CPU time per Cycle: Depends on deployment size and number of equipment to be evaluated. Corps-size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts and data files for postprocessing.

Frequency of Use: Approximately one analysis per year.

Users: USAEPG.

Comments: The model is not machine dependent. However, it takes advantage of the CDC CYBER 60-bit word for optimizations of data storage and access, and would require modification for other environments.

TITLE: IFF SPPM - Identification, Friend or Foe Statistical Performance Prediction Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402.

POINT OF CONTACT: R. Schneider, DSN 281-2355, (301) 267-2355.

PURPOSE: The IFF SPPM is a research and evaluation tool developed to assess IFF system performance in multiple scenarios ranging from one-on-one to full theater level engagements using statistical techniques. The model was designed to predict the performance of IFF systems in any user-defined scenario. The scenario may include platforms equipped with IFF interrogators/transponders, air traffic control radar beacon system (ATCRBS) interrogators/transponders, and hostile platforms including jammers. The model uses a set of rules to determine if an interrogation/response is successful. The model provides interrogation rates at transponders in a scenario. These rates are used to predict transponder reply efficiency. The interrogation rates and reply efficiencies are used to predict the downlink signal environment at selected interrogator receivers in the scenario. Interrogation rates and reply efficiencies are also used to predict interrogator receiver identification performance. It also includes the effects of jamming on the interrogator receiver, transponder receiver, and the primary sensor.

DESCRIPTION:
Domain: Air, land and sea (user-defined).

Span: One-on-one to theater level.

Environment: Smooth earth with multiple propagation paths considered.

Force Composition: Combined, Joint, and NATO forces can be portrayed down to the individual interrogator/transponder/sensor level. Hostile and Neutral forces can be included.

Scope of Conflict: Conventional.

Mission Area: Communications/IFF (identification of friendlies using active measures).

Level of Detail of Processing and Entities: Entity: Each interrogator/transponder performance aboard a platform down to the individual component aboard an aircraft, ship, SAM, MANPAD (e.g., STINGER), etc. Processes: IFF system performance evaluated without platform motion or platform attrition.

CONSTRUCTION:
Human Participation: Required to define type/location/number of forces before model is executed.

Time Processing: Static.

Treatment of Randomness: Deterministic model using stochastic techniques to predict synchronous signal arrivals.

Sidedness: Two-sided. Developed to predict the performance of NATO Identification System, but the scenarios can contain Red forces including hostile jamming effects.

LIMITATIONS: Propagation models are limited to the RF portion of the frequency spectrum.

PLANNED IMPROVEMENT AND MODIFICATIONS: Host to a microVAX and VAX 6000. Modifications to include new IFF and air traffic control (ATC) systems (e.g., NGIFF, Mode-S) are under consideration.

INPUT: IFF C-E systems characteristics and platform deployment required.

OUTPUT: Computer printouts and plots of interrogation/transponder rates and performance provided.

HARDWARE AND SOFTWARE:

Computer(OS):	VAX/VMS V5.4-1.
Storage:	Disk storage requirements vary depending on scenario size.
Peripherals:	Printer.
Language:	FORTRAN 77.
Documentation:	ECAC-CR-91-045 describes the engineering theory, functional description, model hierarchy, subroutine description, data dictionary, computer environment, security procedures, sample run, and verification process.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of large data base can take several man-days.

CPU time per Cycle: Depends on data base size. Generally requires several minutes of CPU time.

Data Output Analysis: Can be interpreted by personnel with IFF experience.

Frequency of Use: Varies, by command.

Users: DoD Electromagnetic Compatibility Analysis Center in support of the Mark XV Identification Friend From Foe System Program Office and NATO Identification System (NIS) Technical Working Group (NTWG).

Comments: Developed to support the Mark XV IFF SPO and used to analyze several system engineering issues regarding the definition of system specifications and NATO STANAG 4162. Also, the model was used to support the frequency allocation effort by predicting IFF signal rates. These rates were used in EMC bench tests involving civil ATC equipment.

TITLE: IMARS - Integrated Missile and Radar Simulation.

DATE IMPLEMENTED: September 1989.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: IMARS is used to assess the performance of RED surface-to-air missile systems against BLUE aircraft.

DESCRIPTION:

Domain: Land and air.

Span: Individual.

Environment: Terrain relief.

Force Composition: Element.

Scope of Conflict: Conventional.

Mission Area: N/A.

Level of Detail of Processes and Entities: Single aircraft versus a single missile system. IMARS simulates: acquisition and track radars, missile propulsion, missile guidance, missile autopilot, and missile aerodynamics. Clutter is simulated based on actual test data.

CONSTRUCTION:

Human Participation: Not required.

Time Processing:

Treatment of Randomness:

Sidedness: One-sided.

LIMITATIONS: Advanced Continuous Simulation Language (ACSL) is required to run a simulation. IMARS does not produce endgame results.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: IMARS accepts radar, wind, target, target flight path, and multipath/clutter data.

OUTPUT: The models produce a time history of the missile flight profile and missile miss distance.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780, MicroVAX, APOLLO, SUN, CDC.
Storage:	2.2 MB.
Peripherals:	N/A.
Language:	FORTRAN 77, ACSL.
Documentation:	ACSL User's Manual, IMARS User's Manuals, Low Altitude Radar Simulation, Engineering Manual for each simulated system.

SECURITY CLASSIFICATION: Secret/NOFORN/WNINTEL.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: IMOM - Improved Many-On-Many.

MODEL TYPE: Analysis.

DATE IMPLEMENTED: 1985.

PROPONENT: Air Force Electronic Warfare Center, Studies and Analysis Direcorate, San Antonio, TX 78243-5000.

POINT OF CONTACT: AFEWC/SAM, AV 969-2521, Comm (512) 977-2521.

PURPOSE: IMOM is used mainly as an operation support tool which displays radar coverage taking in account the order of battle, effects of terrain, electronic combat and weapon systems envelopes.

DESCRIPTION:

Domain: Land, air, and sea.

Span: Global (Depending on the location of the order of battle whether it is electronic, air, naval, or army).

Environment: Uses Defense Mapping Agency (DMA) terrain data and World Database Base II country and political boundaries.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Primarily conventional warfare.

Mission Area: Electronic Combat.

Level of Detail of Processes and Entities: Entities: IMOM models entire orders of battles (hundreds of sites) or just a single site. Electronic order of battles (EOBs) are categorized by function such as early warning or target tracker (SAM or AAA). Processes: Sites can be manipulated (change location, add sites, delete sites, change intel information). Analysis of electronic combat effects for each site is displayed such as radar coverage involving terrain masking, jamming (stand-off jaming, self-protective jamming). Other elements of electronic combat in IMOM are route analysis, combat radius of different aircraft, intel functions, and multiple aids to assist the user in electronic combat planning.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Static.

Treatment of Randomness: Calculations in IMOM are deterministically based on the laws of physics.

Sidedness: Two sided, symmetric, reactive model.

LIMITATIONS: Computer specific (Does not run on a pc). Certain data files are dynamic (radar files).

PLANNED IMPROVEMENTS AND MODIFICATIONS: VAX IMOM 5.0 will be released in the Fall of '91.

INPUT: Terrain, radar files and tables, and order of battles.

OUTPUT: Produces scaled overlays (TPC's, ONC's etc.) of radar coverage including electronic combat effects. Also shown are symbols, text and various user aids.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	25 Megabytes plus terrain.
Peripherals:	1 or more Tektronix terminals, Bruning plotter, Tek 4693 or 4694 printer, standard text printer.
Language:	FORTRAN, DCL.
Documentation:	IMOM manual available.
Computer:	Re-designed to run on SUN SPARC WORKSTATION with UNIX operating system.
Storage:	25 Megabytes plus terrain.
Peripherals:	Bruning plotter, Hewlett Packard PaintJet or PaintJET XL printer, standard text printer.
Language:	C.
Documentation:	IMOM manual available.

SECURITY CLASSIFICATION: Unclassified - source code. Classified - various data bases and data files.

GENERAL DATA:

Data Base: Dependent upon method of entering OB data base (manual or automated).

CPU time per Cycle: Dependent on OB data base size and user needs.

Data Output Analysis:

Frequency of Use: Varies by command. Used extensively throughout the gulf war.

Users PACAF, USAFE, TAC, SAC, ATC, AFSOC, CENTAF, National Guard.

Comments: None.

TITLE: INSSIM - Integrated Sortie Survivability Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Averue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill ŀigh, ITT Avionics, (201) 284-2870.

PURPOSE: A Sortie Survivability Model suitable for mission tradeoff analysis.

INPUT: 3-d weapon lethality/engagement-envelope matrices, threat system parameters, aircraft rcs/angle, MSFD threat laydown, aircraft flight path.

OUTPUT: Pk/Ps totals, per-threat-type, per-threat + color graphics display.

DESCRIPTION: Flies a single aircraft (on simple way-point path), with given ECM suite, through a user specified threat laydown determining engagements and calculating total mission as well as per-threat-type survivability. Engagement Ps/Pk values are calculated using ECM affectivity data, threat lethality data and number of shots.

HARDWARE AND SOFTWARE:

Computer:	VAXStation 3100; could be transported to other DEC/VAX CPUs.
Storage:	Approximately 20M Bytes; memory requirements: nominal.
Language:	FORTRAN 77 + DEC UIS graphics driver.
Documentation:	Top level at this time.

SECURITY CLASSIFICATION: Unclassified code; classified data.

GENERAL DATA:

Data Base: Data preparation could take anywhere from minutes to days (and days).

CPU time per Cycle: The main program runs in real time or better.

Usage: ITT Advanced ED analysis.

Comments: The main INSSIM module provides dynamic, real time, interactive color display of aircraft, flight-path, threat laydown and engagements with lethal threat envelopes even as it calculates Ps/Pk values. INSSIM also includes data prep modules (such as the missile flyout, acft detection and threat laydown programs) which allows the user to create the large input data bases "offline". Flight path inputs consist of small files containing a few lat-long way-points including altitude. This is a 4/3rds Earth model with no terrain. Intervisibility is computed as a function of altitude.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: IPARS - Integration Period Airborne Radar Simulation.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC).

POINT OF CONTACT: Mark D. Bond, SAIC, (404) 426-9359.

PURPOSE: The purpose of IPARS is to determine the detectability of airborne radar against an aircraft with a given cross section in an environment with limited clutter. Detection templates for user input aspect angles around the aircraft are often fed to the mission level and campaign-level models such as SPEED and COMMANDER.

DESCRIPTION:

Domain: Air.

Span: One aircraft on one radar.

Environment: Round, smooth earth; atmospheric absorption.

Force Composition: Single element BLUE vs. RED or RED vs. BLUE.

Scope of Conflict: Accommodates airborne acquisition and fire control radar, although tracking radar is limited to detectability only. Aircraft are represented by Swirling/Barton theoretical fluctuation models.

Mission Area: Single penetrator with jammer against a single radar.

Level of Detail of Processes and Entities: Lowest entity modeled is a radar subsystem: transmitter, pulse doppler or MTI circuit, noncoherent integrator, gain control. Pulse doppler and MTI processing limited to single spectral return in user-defined filter. Target fluctuation models limited to Swerling 1-4 Chi-squared, Weinstock, and nonfluctuating. Clutter reflectivity is a user input constant.

CONSTRUCTION:

Human Participation: Not required or permitted.

Time Processing: Dynamic, closed form solution. Determines detectability of aircraft of constant heading for 0-360 degrees viewing aspect angle over a user-specified distance.

Treatment of Randomness: Deterministic; random noise sums to the mean (deterministic) over an integration period.

Sidedness: Symmetric.

LIMITATIONS: Does not model angle, range, or doppler tracking. Target fluctuation limited to models 1-4, Chi-Squared, Weinstock, or nonfluctuating.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Moving target detector (MTD: MTI followed by pulse doppler) capability and monopulse angle tracking will be added. Integration period algorithms for coherent jamming will be designed.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer: Designed to run on VAX computer with VMS operating system.

Storage: IPARS executable = 15,000 bytes. Input files = 65,000 bytes each (including antenna patterns).

Peripherals: No peripheral support required for operation. A graphics display terminal to view templates is recommended.

Language: FORTRAN.

Documentation: A user's manual and input guide are available.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base construction time is minimal provided that preparation is performed by a qualified radar analyst.

CPU time per Cycle: Depends on number of simulation points and radar's pulse repetition frequency (PRF). A higher PRF requires more clutter calculation. A 100 km range simulation performed at 1-degree intervals would require approximately 15 CPU minutes on a 4-MIP machine.

Data Output Analysis: Depends on level of engineering skills.

Frequency of Use: Extensive use by airframers in the analysis of low observables (LO) design.

Users: N/A.

Comments: Configuration is controlled by SAIC.

TITLE. IPOWS - Intelligence Processing Operator Workstation Model.

DATE IMPLEMENTED: January 1990.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: John Ellinger, (301) 278-6423, DSN 298-6423.

PURPOSE: Provide a tool for evaluating the capability and performance of IEW processing systems (fusion).

DESCRIPTION: Version 1 of IPOWS is a flow model. It emulates the flow of messages from sensor assets through communications relays to the intelligence production cells at division and corps (MI Bde, MI Btn, DTOC, CTOC). The model emulates the flow of information and processing steps carried out at and between these cells.

Domain: Command and Control, IEW assets.

Span: Corps and division level.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: Situation dependent.

Mission Area: Intelligence and Electronic Warfare.

Level of Detail of Processes and Entities: Entities: Communications modules, analyst workstations, enclaves containing analysts and equipment, network connectivities. Processes: Movement of enclaves and equipment, equipment failures, message processing (parsing, correlation, etc.), communications/message routing.

CONSTRUCTION:
Human Participation: Only needed for building input files.

Time Processing: Dynamic, event-step simulation.

Treatment of Randomness: Reliability and routing of messages (possible paths a message could take) are treated stochastically. Movement and various (mean) processing times are deterministic.

Sidedness: One-sided.

LIMITATIONS: Target data (message content) are not addressed in the model, thus actual intelligence analysis and processing algorithms are not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of message content and processing algorithms.

INPUT: Sensor types and number, message generation rates, processing assumptions, timing parameters for each processing steps, allocation of analysts and workstations, network connectivities (communications, LANs).

OUTPUT: Tabulated statistics and information conveying the final state of the system and its entities (e.g., queue lengths, utilization, availability, etc.).

HARDWARE AND SOFTWARE:

Computer:	VAX 11/785 (VMS).
Storage:	160 Kilobytes.
Peripherals:	Line printer.
Language:	SIMSCRIPT II.5, Release 5.1, no hardware specific code.
Documentation:	User's Guide, includes design documentation.

SECURITY CLASSIFICATION: Source code unclassified, inputs and outputs secret.

GENERAL DATA:

Data Base: 3 to 6 hours to build a set of input files.

CPU Time per Cycle: Approximately 1 hour of run-time to simulate 5 days.

Data Output Analysis: System performance, situation specific.

Frequency of Use: Upon demand.

Users: U.S. Army Materiel Systems Analysis Activity.

Comments: The model has recently been transferred to Argonne National Lab for continued development and improvement. In addition, the model has been given to the U.S. Army Intelligence Center and School at Ft. Huachuca.

TITLE: IREM - Integrated Research, Evaluation, and System Analysis Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis, but also being used as an exercise driver and training model).

PROPONENT: Naval Surface Warfare Center, White Oak Laboratory, Code D25, 10901 New Hampshire Ave., Silver Spring, MD 20903-5000.

POINT OF CONTACT: Jim O'Brasky, (703) 663-7369, AV 249-7369.

PURPOSE: IREM is used primarily to analyze force level assessments. It is specifically designed to investigate battle group and force level operations and to be a training model with capabilities to simulate air, surface, and subsurface platforms.

DESCRIPTION:
Domain: Land, sea, air, space, and undersea.

Span: Theater; large-scale warfare simulation.

Environment: All weather, all seasons (limited data bases).

Force Composition: N/A.

Scope of Conflict: Primarily conventional warfare and some limited nuclear weapons.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: IREM is a federation of a high level executive model (RESA) with Battle Damage Assessments (BDA) models, and LOGISTICS models, and high fidelity engagement models for each warfare area. IREM is capable of simulating on-board and off-board electromagnetic and acoustic sensors, navigation, ship and shore damage, communication networks, sensor jamming, surveillance satellites, and cruise missiles. IREM supports a two-sided interactive scenario in which opposing sides can define, structure, and dynamically control forces ranging in size from multi-carrier battle forces and associated aircraft to a single air or surface unit. It can display an "umpire's" view as well as those of the elements of the RED and BLUE command structures.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic and deterministic.

Sidedness: Three-sided, symmetric, reactive.

LIMITATIONS: Does not model naval mine warfare, striker against land targets, or amphibious warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: IREM is being enhanced and integrated with other models into a high fidelity analysis tool, and run speed is being increased.

INPUT: Scenario, acoustic environment data, sensor characteristics, weather, platform characteristics, etc. Most of this data is in the data bases.

OUTPUT: The output consists of all the displayable information (weapon availability, damage report, detection report, communications reports, measures of-effectiveness, etc.) available to the user via the Status Boards, Geo-Tactical Iilot, and hardcopy. In addition, the true position of units and tracks and the true identity of tracks are displayed on the Control Status Boards. Automated data extraction, reduction, and display features have been demonstrated.

HARDWARE AND SOFTWARE:

Computer: Designed to run a VAX computer with a VMS operating system and connected to the IBM PCs.

Storage: Approximately 120 MB.

Peripherals: Minimum requirements for one Command Station: one printer, one Tektronix graphic display, one tablet, three VT100, one I/O terminal for command input.

Language: RATFOR (Rational FORTRAN), FORTRAN 77.

Documentation: Extensive documentation of inconsistent quality.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Population of large data bases can take several man-months to several man-years.

CPU time per Cycle: Depends on data base size, player configuration, and host computer characteristics. Large exercises can take hours of CPU time to process hours of combat. Maximum exercise rate is 6:1.

Data Output Analysis: Postprocessor aids in analysis of output. Produces hardcopies of raw data, automated data reduction, and partial report generation.

Frequency of Use: Varies by command.

Users: SPAWAR 31F, NSWC D25, Navy Lab Force Assessment Community.

Comments: IREM is an ongoing project. It is being enhanced, modified, and integrated into a high fidelity analysis tool.

TITLE: IRIS II - Infrared Imaging Seeker II.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The IRIS II - Infrared Imaging Seeker II - Program is a generic computer simulation of the first generation infrared (IR) imaging missile seeker. The program currently models a captive seeker, one where the missile flight path is in a straight, predetermined direction or held in a fixed position. The intent of the model is to predict tracking characteristics of a first generation IR imaging seeker for a specified target and decoy scenarios which can be compared to tracking data from captive seeker tests.

DESCRIPTION: IRIS II is based upon the FASTUSA Model with the addition of several model modifications and enhancements. Both computer models determine seeker signal processing signals, bi-level video output, tracking logic and seeker gimbal movement. The FASTUSA Model was developed to be used in a specific missile simulation, hence it allowed for no user input or variation of run time conditions. The IRIS II model allows user specification of input parameters describing scenario conditions and the seeker attributes. Scenario conditions to be input include positions and directional velocities, if any, of the missile, the target plane and the individual targets/decoys within the target plane. Target radiances are user specified by effective radiation temperatures for the appropriate spectral waveband of the seeker. Seeker attributes to be input by the user include FOV, scan rate, scan efficiencies, number of IR and TV scan lines and spectral waveband.

Atmospheric effects are incorporated into the IRIS II model using LOWTRAN 6 as a subroutine. Atmospheric conditions to be user specified include model, haze, visibility, date, time, latitude and longitude. Default values for atmospheric parameters are included in the model and may alternately be chosen.

INPUT: The input for IRIS II consists of nine records in one data file. This data consists of missile information, target information, simulation time, atmospheric conditions, day, time, position of observer, and output desired.

OUTPUT: Full program output consists of an input data summary, LOWTRAN 6 radiance calculations and results of selected fields in modes 1, 3, and 4. Output in mode 1 includes a sampled radiance map of the scene within the video processor gates and signal processor values at the end of the field. Mode 3 output contains gate size and position, video threshold data and a sampled bi-level video map within the video processor gate. Mode 4 output includes a sampled source number map, gate and video threshold data, a sampled bi-level video map, signal processor values and seeker tracking information.

An example run presenting a full program output is given in the IRIS II User's Manual.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	IRIS II Model: 852,303 bytes. LOWTRAN 6 subprogram: 372,538 bytes.
Language:	FORTRAN 77.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:
Time Requirements: Compilation time: IRIS II model: 52.21 CPU seconds. LOWTRAN 6 subprogram: 174.71 CPU seconds. Typical Run Time: Scan 60 fields-of-scene with 2 backgrounds (sky/sea) and 1 target.

Users:

AFEWC/SAM
ASDI
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
ECAC
General Dynamics/Convair Division
Logicon, Inc.
Mitre Corporation
NASA Lewis Research Center
Naval Air Development Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Defense Systems Division
OptiMetrics, Inc.
SAIC
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
United Technologies
WL/AAWW-3
Westinghouse Electric Corporation.

TITLE: IRPD - Infrared and Pulse Doppler Program.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The IRPD program is a computer program which calculates the range at which a combined Infrared (IR) Scanning and Pulse Doppler (PD) Radar Warning System can detect a missile.

DESCRIPTION: The program is used to determine the detection range of an air-launched or ground-launched missile approaching a penetrator equipped with an IRPD warning system. The forward coverage is provided by PD radar only, while the aft coverage is provided by a combined IR scanning and PD radar system.

The initial range between the missile and the penetrator is calculated from the input geometry. Since IRPD forward aspect coverage is provided by a PD radar only, while aft aspect coverage is provided by a combined IR scanning and PD radar system, the missile angle-of-approach is calculated at each time increment to determine which mode of operation is to be used. If the missile is within the forward aspect coverage of the IRPD (radar only), the signal strength of the missile echo is calculated and compared with the PD threshold and superthreshold detection levels to determine the detection range and the time to the closest point of approach. If the signal strength of the missile echo exceeds the PD superthreshold, the detection is flagged. If the missile is within the aft aspect coverage of the IRPD system, the program calculates the missile IR signal strength and compares it with the IR detection thresholds. When the missile IR signal strength surpasses the detection threshold, the missile is turned over to the PD radar subsystem for verification of the threat. The IR signal strength of the missile is also constantly compared with the IR threshold level. If the IR signal exceeds the IR threshold during the PD processing the missile is regarded as a threat regardless of PD status and the time to the point of closest approach is calculated.

INPUT: The engagement geometry and the signature characteristics of the missile (the spectral radiant intensity as a function of time and aspect angle and the Radar Cross Section (RCS) as a function of aspect angle) are provided by the user. IRPD system parameters default to values found in a prewritten data file, or may be user input if desired. The penetrator flight path is modeled by a flight path generator. The missile flyout is provided by other programs. The atmospheric transmittance calculations are performed by LOWTRAN 6. Detection by the IR scanner is calculated using algorithms and subprograms from the LOCNES model and the radar range equation is used to calculate the target signal strength at the radar receiver.

Meteorological condition options can be set by the user. One combination of the following atmospheric and haze models (the model-atmosphere and haze data are contained in the LOWTRAN 6 program) must be selected:

Model Atmospheres:	Haze Models:
Tropical	Rural
Midlatitude Summer	Maritime
Midlatitude Winter	Urban
Subarctic Winter	Tropospheric
Subarctic Summer	Advection Fog
1962 U.S. Standard Atmosphere	Radiation Fog

OUTPUT: Program output will consist of a summary of program input followed by:

- Time, range, and target irradiance when IR detection occurs.
- RF signal strength of target at time of PD radar detection.
- Average detection range of target and time to the closest point of approach, and the tolerance range.
- IR superthreshold detection, T or F.
- PD superthreshold detection, T or F.
- Closest point of missile approach.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage: 398,073 bytes.
Language: FORTRAN 77.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 18.5 seconds; Typical run time: 127 seconds.

Users:

AFCSA/SASB
AFEWC/SAT
ASD/ENSSS
ASD/XRHD
ASD/XRM
ASDI
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
Dalmo Victor Inc., The Singer Company
E-Systems, Greenville Division
GTE Government Systems Corporation
General Dynamics Corporation
General Dynamics/Convair Division
General Research Corporation
Hughes Radar Systems
Kaman Sciences Corporation
Loral Advanced Projects
Loral Electronic Systems
McDonnell Aircraft Company
Merit Technology Inc.
NASA Lewis Research Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Defense Systems Division
OptiMetrics, Inc.
SAIC
TRW/Military Electronics & Avionics Division
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
W J Schafer Associates.

TITLE: ITAM - Interdiction Tanker Analysis Model.

DATE IMPLEMENTED: ITAM is still under development.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis, Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: Frederick J. Blume, Boeing Military Airplanes, Operations Analysis, (316) 526-2956.

PURPOSE: The purpose of the ITAM is to simulate the air refueling operations involved in support of the air interdiction mission. The model is designed to optimize the tanker mix to meet differing objectives. The model will complement and become a part of the campaign simulation set.

DESCRIPTION:

Domain: Air.

Span: Global.

Environment: Altitudes and distances.

Force Composition: Attack forces and supporting tankers.

Scope of Conflict: Flights, groups, and forces.

Level of Detail of Processes and Entities: Main entities are individual aircraft (receivers and tankers). The processes modeled include aircraft flight, weapon delivery, and air refueling.

CONSTRUCTION:

Human Participation: Required to set up data files for execution. Future development of the ITAM may allow the user to interactively modify conditions in the scenario during a run.

Time Processing: Event-driven model that steps through events scheduled by input data files and by the model itself.

Treatment of Randomness: The model is deterministic.

Sidedness: One-sided.

LIMITATIONS: At the present time, theater-level operations are the limiting scenarios.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A number of improvements are being considered. These include inclusion of threats in the theater and aircraft survivability based on those threats, an ability to alter the scenario interactively during a run or at specific times determined prior to run time, and improved preprocessing functions.

INPUT: Input files are required to provide the following information: location information for all origins of tankers and receivers in addition to the targets of receivers in the theater, aircraft data, and aircraft beddown data.

OUTPUT: Output will include tanker requirements, fuel offloads, fuel burns, mission feasibility determinations, and scheduling reports for tanker refueling missions, as required.

HARDWARE AND SOFTWARE:

Computer: The model is being developed to run in a network of APOLLO DN3000 and DN660 terminals running an AEGIS-DOMAIN/IX (UNIX-based) operating system, software release 9.5.

Storage: Unknown for the executable model. Data bases may require considerable additional space.

Peripherals: 1 printer and 1 terminal.

Language: APOLLO/DOMAIN Pascal, APOLLO DOMAIN/IX operating system calls, and a data base management system that makes calls to Boeing Military Airplanes' Aircraft Data Base.

Documentation: An initial methodology document are currently available.

SECURITY CLASSIFICATION: Unclassified, but data could be classified.

GENERAL DATA:

Data Base: Development of data bases could take a considerable amount of time. We have several sets of scenario data modified from previously modeled tanker missions.

CPU time per Cycle: Unknown at this time.

Data Output Analysis: Output reports will provide a considerable amount of summary data for use in verification of mission objectives. The scheduling report will be used to verify actual tanker schedulings and missions made during the run.

Frequency of Use: Will be used on an as needed basis for air interdiction tanker analyses.

Users: Boeing Military Airplanes, Operations Analysis, Tanker/Airlift Program Support.

Comments: N/A.

TITLE: IWSS - Interactive Weapon System Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: General Dynamics, Air Defense Systems Division, Pomona, CA, 91769-2507.

POINT OF CONTACT: R.B. Hoffman; C.Y. Lee, (714) 868-4693.

PURPOSE: IWSS is used primarily to analyze both individual unit and force weapon system effectiveness in an interactive environment. It is also designed to permit conduct of effectiveness analysis in a prescripted mode without human operators as decision makers. The simulation allows detailed assessment of weapon performance in realistic end-to-end battles.

DESCRIPTION:
Domain: Air, land and sea.

Span: Regional, Local and/or Individual.

Environment: DMA terrain, different sea states, static regional weather grid in which cloud type formation and rain is specified for each subgrid, LOWTRAN 6 atmospheric data.

Force Composition: Joint, combined and element forces, Blue and Red.

Scope of Conflict: Primarily conventional warfare with virtually all conventional weapons and their effects modeled.

Mission Area: Tactical Air Power Projection, Tactical Air Strike Escort, Naval Outer Air Battle, Naval ship based area defense, Ground based air defense against aircraft and missile threats.

Level of Detail of Processes and Entities: Each asset is individually modeled by describing the details of its sensor, weapons, ECM and fire control suite. Inasmuch as all sensor interactions are calculated using the appropriate RF or IR range equations, fidelity is dependent upon the level of data provided. Weapon system performance is determined using either a 3DOF or 5DOF kinematic subroutine (user choice) plus seeker acquisition and miss distance models. The model can accommodate up to 500 assets. Assets include aircraft, ships, SAM sites, airbases and ground control Units. Movement of assets directives can be issued by groups or individually. Assets can be grouped together for mission enhancement. Communication of information is performed on an individual basis. Attrition of assets are probability of kill, Monte Carlo based. Aircraft fuel loads, fuel burn rates as a function of speed, bingo state, missile loadouts, ECM suite (frequency and power) are examples of the characteristics used to model an aircraft asset. Similar detail is used for other modeled assets.

CONSTRUCTION:
Human Participation: Required for decisions and processes, but can allow model to perform decisions based on developed logic.

Time Processing: Dynamic, time- and event-stepped model. Progresses through events at a user-specified ratio of execution speed to real time.

Treatment of Randomness: Attrition of assets are performed by two methods. The first method is stochastically based on probability of kill (Pk) and the second method is determining Pk by miss distance, with Monte Carlo determination of result. Other than this, the model is basically deterministic.

Sidedness: Two-sided, symmetric, reactive model. Can be tested by a single operator and operated by as few as 1 or as many as 30 operators .

LIMITATIONS: Does not model air-to-air dogfights, ground combined arms combat, naval mine warfare or undersea operations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None planned. Model is mature and documented.

INPUT: Relevant inputs include terrain, weapons, sensors, aircraft, ships, land sites, airbases, weather grid, atmospheric data, tactical decision tables.

OUTPUT: Produces printouts of attrition, major event occurrences, weapon usage, and individual asset status. Provides graphical displays for asset status and control, scenario representation and wargame checkpoint/restarts. Generates 9-track tapes for storage of wargame for future playback purposes.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system. Graphical displays are designed for MicroVAX family of computers.
Storage:	100,000 blocks.
Peripherals:	Minimum requirements: 1 Microvax, 1 graphics suite, 1 VT100 terminal, 1 Printer.
Language:	SIMSCRIPT II.5, FORTRAN, DCL.
Documentation:	3 Published reports.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified. Model is a General Dynamics Proprietary Program.

GENERAL DATA:

Data Base: 2-3 weeks for small scenarios, 1-2 months for large scenarios.

CPU time per Cycle: Dependent on data base size and player configuration. For small scenarios can operate at 20 times or more of real time or for large scenarios can take hours of CPU to process hours of combat.

Data Output Analysis: Postprocessor aids in analysis of outputs. Produces hardcopies of raw data.

Frequency of Use: Used at least several times per year.

TITLE: JAGUAR - Juego de Guerra Aereo Americano Regional.

DATE IMPLEMENTED: August 1988.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: JAGUAR requires players to make the kinds of decisions an Air Component Commander, a Chief of the Tactical Air Control Center (TACC), and their senior staffs would make. (See also ARROW.)

DESCRIPTION: JAGUAR is an automated, two-sided, airpower employment exercise. It concentrates on air operations with ground and naval units and actions serving as targets and as a framework for viewing the air war.

Domain: Air operations only.

Span: Two fictitious South American countries, two neutral border countries, coastal areas, and open ocean.

Environment: JAGUAR includes both day and night operations. It includes weather and distance factors.

Force Composition: Tactical air forces.

Scope of Conflict: Conventional and low-intensity warfare.

Mission Area: Conventional missions including: Air Interdiction, Battlefield Air Interdiction, Close Air Support, Offensive Counter Air, Defensive Counter Air, Special Operations Force insertions, Electronic Counter Measures, Forward Air Control, Reconnaissance, Airlift, and Suppression of Enemy Air Defenses.

Level of Detail of Processes and Entities: ACC, TACC, WOC levels.

CONSTRUCTION:
Human Participation: Required for process and analysis.

Time Responses: Game combat adjudication is based on individual Air Tasking Order line time periods with the adjudication process run in batch mode to evaluate a complete combat day's input for red and blue.

Treatment of Randomness: Monte Carlo determination on the probability of event occurrence with deterministic table look ups for combat attrition.

Sidedness: Two-sided, with Blue and Red teams.

LIMITATIONS: Movement of ground and naval units is done by controllers or is scripted.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved air-to-air combat including Combat Air Patrols, Escort, and Defensive Ground Alert missions; Spanish language menus; consideration of hardening and unit size in determining attrition; logistics accounting; and data base maintenance module.

INPUT: Both Red and Blue teams create Air Tasking Orders containing separate line entries for each mission to include: line number, aircraft type, standard conventional weapons load (SCL), number of sorties scheduled, originating base, target, and time period.

OUTPUT: JAGUAR permits the players to generate combat resolution reports, reconnaissance reports, SCL reports, Target lists, air base lists, aircraft mission capability reports, aircraft beddown reports, and air tasking orders. Players can also view 18 different graphs showing scheduled/unscheduled sorties for each mission type by aircraft, combat losses, maintenance, diverts, etc.

HARDWARE AND SOFTWARE:

Computer(OS):	IBM-compatible MS-DOS machine with floppy and hard disk drives, 640 Kilobytes of random access memory, and a printer. Also requires the Smart System Spreadsheet from Innovative Software.
Storage:	Requires 340 kilobytes for project files and basic work files plus 200 Kilobytes for each day of the war; 2 megabytes for Smart software.
Peripherals:	Monochrome monitor (color optional), printer.
Language:	Smart System Project Commands.
Documentation:	User manuals available.

SECURITY CLASSIFICATION: Latin America scenario is unclassified.

GENERAL DATA:

Data Base: About 1 man-month to rebuild data base.

CPU time per Cycle: Not applicable.

Data Output Analysis: Hardcopy via line printer and some on-screen graphic displays. Includes special controller output report for combat resolution debugging and option for on-screen combat resolution display for each ATO line entry as it is processed.

Frequency of Use: Twice per year.

Users: Inter-American Air Forces Academy.

Comments: Managed through review and configuration control board at the AFWC.

TITLE: Janus.

DATE IMPLEMENTED: 1978 (latest version June 1991).

MODEL TYPE: Depending on the needs of its users, Janus is being used for both analysis and training and education.

PROPONENT: Conflict Simulation Laboratory, Lawrence Livermore National Laboratory, P.O. Box 808 L-315, Livermore, CA 94550.

POINT OF CONTACT: Jeffrey E. Pimper, (510) 422-6568.

PURPOSE: Janus has been used as a research & evaluation tool to evaluate the effectiveness of new weapons systems and new tactical doctrines. It has been used to investigate courses of action for both Just Cause and Desert Storm. It is being used as a training tool for battalion and brigade commanders. It has also been used as a driver for command post exercises.

DESCRIPTION:

Domain: Land with limited air and naval operations.

Span: Largest use was for Desert Storm, with 22 divisions over a 600 kilometer square area. Smallest use for site security training and analysis, with 50 individual soldiers in a 400 meter square area.

Environment: Rectangular grid based. Each grid contains data on elevation, foliage or building height and density, nuclear effects (fire and blowdown), rivers, and roads. Weather is variably defined but constant during duration of play. Day operations only.

Force Composition: Joint and combined forces. Blue and Red.

Scope of Conflict: Conventional warfare with tactical nuclear, microwave, and advanced conventional weapons. All data is external and editable by the user so virtually any imaginable conventional weapon may be modeled without the necessity to modify source code.

Mission Area: Both conventional and unconventional warfare has been modeled, including sea control and airlift operations. Models air-to-ground and ground-to-air combat. Models air-to-air for rotary-wing aircraft only.

Level of Detail of Processes and Entities: Individual game units can represent from one to fifteen item systems. There can be up to 999 units per side. Orders and plans are given at the game unit level. Line-of-sight and acquisition is also done at the unit level. All other combat processes are done at the item system level. Attrition is done via probability of hit and kill, Monte Carlo based, and adjudicated at the item system level.

CONSTRUCTION:

Human Participation: Required to enter initial plans and orders. Janus can be run in systemic mode without human participants for analysis or it can be run in interactive mode with humans interacting and changing plans at real time.

Time Processing: Dynamic, event-stepped. During interactive play Janus is slowed down so that it runs at no faster than real time.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric. Whether or not forces react depends on whether or not the force has a human player assigned to it. Can be operated with no players (systemic mode), a single player, or as many as 32 players.

LIMITATIONS: Limited to 999 units per side, 15 item systems per unit. Maximum terrain resolution is 1000 x 1000 terrain cells (100 km square at 100 meter resolution, 1 km square at 1 meter resolution, 600 km square at 600 meter resolution). Does not model air-to-air combat for fixed wing aircraft. Does not model undersea operation nor some aspects of ship-to-ship fighting.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expand the scope to allow for Joint Operations planning and training. Expand to 24 terminals and 48 players. New, faster algorithms are being developed to allow larger games to be played. Looking at migrating to RISC/UNIX with X-WINDOW systems.

INPUT: All modeling data is external to the model. This includes all weapon and platform characteristics, PH/PK data, terrain, force organization, and force orders and plans. Even the graphic symbology used may be modified by the user.

OUTPUT: Produces formatted status and loss reports. Also produces event history files which can be used with the Analyst Workstation postprocessor to analyze the results of the game and to create after action reviews. The history file includes movement, combat and attrition, logistics, and intelligence information.

HARDWARE AND SOFTWARE:

Computer:	Will run on any VAX computer with the VMS operating system.
Storage:	80,000 blocks for the Janus software itself. 300,000 blocks for users.
Peripherals:	Minimum requirement for analysis: 1 printer, 1 VT-100 compatible terminal, 1 Tektronix 4225 workstation with 4 MBytes of memory and one graph tablet. Add a second 4225 for training. A full-up system has 16 Tektronix 4225 with two graph tablets each.
Language:	VAX FORTRAN, DCL. INGRES is optional.
Documentation:	Extensively documented with 6 published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Initial data bases may take several man weeks.

CPU time per Cycle: Highly dependent on scenario size and computer speed. Company size scenarios typically run faster than real time and have to be slowed down if there are human interactors. Battalion/Brigade scenarios run at or near real time. Larger scenarios typically run slower than real time.

Data Output Analysis: Analyst Workstation (AWS) postprocessor allows after action review within minutes of game completion. Statistical analysis using AWS and provided relational data base may be completed in a few hours.

Frequency of Use: Depends on the individual users. Some use it daily, others weekly, the rest use it on a monthly or quarterly basis.

Users: Lawrence Livermore National Laboratory, Joint Warfare Center, MARDEZPAC, SOCOM, SOUTHCOM, USAEUR. Berlin Brigade, Fort Lewis, Fort Huachuca, USA War College, USA TRAC Monterey, USAF Wargaming Center, USAF Combat Ops Division, USMC Warfighting Center, USMC Wargaming Center, Institute for Defense Analysis, Intelligence Threat Analysis Center, Sandia National Laboratory, Atomic Weapons Establishment (England), Canadian Defense Headquarters, Warrior Preparation Center (FRG).

Comments: Managed by Lawrence Livermore National Laboratory which also sponsors an annual Users Group meeting. Continually upgraded based on user needs.

TITLE: Janus 4.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis and training.

PROPONENT: Conflict Simulation Laboratory, Lawrence Livermore National Laboratory, P.O. Box 808 L-315, Livermore, CA 94550.

POINT OF CONTACT: Jeffrey E. Pimper. (415) 422-6568, FTS 532-6568.

PURPOSE: Janus 4.0 has been used as an analysis tool to evaluate the effectiveness of new weapon systems and warfare concepts. It has also been used as a training tool, both as a command post exercise driver and as a mission plan evaluator.

DESCRIPTION:
Domain: Land and limited air units.

Span: Has been used with force sizes from squad to division level at item system resolution.

Environment: Digitized terrain from DMA or other data bases for elevation with cultural features overlay. Roads and rivers are explicitly modeled. Daytime and limited nighttime play are modeled. Weather can be changed but remains constant during game play.

Force Composition: Joint and combined forces, both RED and BLUE.

Scope of Conflict: Conventional, advanced conventional, beam and nuclear weapons, and limited chemical effects.

Mission Area: All conventional land operations.

Level of Detail of Processes and Entities: Up to 500 units per side, each composed of 1 to 15 homogeneous item systems. Acquisition is performed at the unit level but attrition is done at the item system level. Attrition is stochastic. Logistics and resupply can be played.

CONSTRUCTION:
Human Participation: Janus 4.0 can be used with or without human participation. With human participation, up to 16 players can freely interact with their units during the game. The human player performs all planning functions. Without human interaction, a preplanned scenario may be played in batch mode. The model is interruptable on a fixed time-step and may then be reinstated in either mode.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Does not explicitly model sea assets or air-to-air combat. Limited to 500 units per side and 99 different system types per side. Terrain resolution limited to 400 x 400 cells, but the cells may be of arbitrary size. Uses simple models for chemical effects and engineering obstacles.

PLANNED IMPROVEMENTS AND MODIFICATIONS: New, faster, and more accurate line-of-sight process; additional advanced conventional munitions; and more detailed engineering and chemical models.

INPUT: Terrain file, pH/pK file, user-defined symbol file, and scenario file that contains all system and unit characteristics, coefficients and parameters used by the algorithms in the model, and unit orders and plans.

OUTPUT: Players sitting at graphic workstations displays, which are continually updated during the game play, can request various status and spot reports at that time. Status, spot, and event data may be written to disk during game play for later postprocessing.

HARDWARE AND SOFTWARE:

Computer:	Any VAX computer, from VAXstation 2000 through VAX 8800. Uses the VMS 5.0 operating system.
Storage:	Minimum requirement: 100,000 blocks. Large scenarios may generate large output files, up to an additional 100,000 blocks.
Peripherals:	Minimum requirement: one Tektronix 4225 workstation (two required for 2-sided game play) with one graph tablet and one VT100 or compatible terminal. Can expand up to eight workstations with two graph tablets each. Printer not required but many printed reports are available.
Language:	VAX FORTRAN.
Documentation:	Janus 4.0 Users Manual and Janus 4.0 Algorithms Document.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Creating new data bases can take from one man-day to one man-month depending on size and complexity.

CPU time per Cycle: Scenario-dependent.

Data Output Analysis: The user determines which spot, status, and data are to be output to disk. Some reports can be printed, while the rest may be read into a relational data base management system for postprocessing.

Frequency of Use: Varies by installation.

Users: Lawrence Livermore National Laboratory, SOUTHCOM, Institute for Defense Analysis, Canadian National Defense Headquarters, Atomic Weapons Establishment in Britain, Command and General Staff College, Battle Simulation Center Ft. Lewis, USAICS Ft. Huachuca, USMC Quantico, and several others.

Comments: Developed and managed by Lawrence Livermore National Laboratory. Installation under site-specific MOA at government-approved sites. Source files are not distributed to users. Continually upgraded based on user requests.

TITLE: JANUS Army.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and Analysis (combat development).

PROPONENT: TRADOC Analysis Command for Analysis (CD) and Combined Arms Command-Training, ATTN: ATZL-CTS-BB, Ft Leavenworth, KS 66027-7301.

POINT OF CONTACT: LTC G. Nance/MAJ M. Lehnherr, AV 552-3189/3395, Commercial (913) 684-3189.

PURPOSE: Analysis (CD) - Model undertakes analytical studies of both current and new doctrine, related to strategy, policy and weapon system development. Training - Primary mission, trains battalion level and below in battle focused training to enable junior leaders to synchronize the battlefield. Secondary mission is to function as a seminar exercise driver for the tactical commanders development program.

DESCRIPTION:

Domain: Land and air space relevant to army operations up to and including brigade level.

Span: Accommodates any theater dependent on data base and availability of OMA digital terrain data.

Environment: Provides digital map display (two dimensions) of military topographical maps and data.

Force Composition: Primary use is for Army operations, but can support combined and joint land operations.

Scope of Conflict: Primarily conventional with limited chemical play. No nuclear.

Mission Area: All missions pertaining to the AIRLAND battle up to brigade level operations. Limited airlift and no CSS play.

Level of Detail of Processes and Entities: Individual soldiers and weapon systems.

CONSTRUCTION:

Human Participation: Required for both decisions and processes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, combination of direct computation and Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides relative.

LIMITATIONS: Model only recently adapted to training use. A joint training/analysis (CD) programming team is being established at TRAC White Sands Missile Range to provide PDSS under TRAC configuration management.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model currently serves analysis (CD) community very well. From Sep 91, priority of development effort will be to improve model for training use.

INPUT: Takes as input movement of red and blue forces; once line of sight, detection and engagement occurs, combat is resolved.

OUTPUT: Produces screen output of combat resolution; e.g., casualties, vehicle damage, ammo/fuel consumption, etc. Printouts available showing kill/loss scoreboard by weapon type, range, etc. Analytical workstation allows for detailed AAR replay of each game.

HARDWARE AND STORAGE:

Computer:	VMS (OS) can run on any VAX CPU from Micro VAX 3100 upwards.
Storage:	12 MB main memory plus 600 MB of high speed disk storage.
Peripherals:	4225 Tektronix workstation (up to 16 in one system) which consists of a 19" color monitor with data tablet, key pad and mouse, printer.
Language:	FORTRAN.
Documentation:	In process of preparation - limited.

SECURITY CLASSIFICATION: Unclassified model. Some data bases for analysis (CD) are classified, dependent on the task.

GENERAL DATA:

Data Base: Analysis (CD) - Initial preparation from two to four man months; updates two to 10 man days. Training - three days with a prepared data base.

CPU time per Cycle: Scenario dependent but runs at real time.

Data Output Analysis: Analysis (CD) - determined dependent on analytical task. Training - Output is analyzed primarily during the course of each game and during AAR at conclusion.

Frequency of Use: Analysis (CD) - Frequent Ad Hoc use for specific analytical tasks. Training - Regular training programs 30 separate exercises at each simulation center.

Users: Analysis (CD) - Wide range of analytical organizations; all TRADOC schools in Army. Training - Currently fielded at CGSC, USAREUR, and I Corps. FY92-95, JANUS will be progressively fielded across U.S. Army at Corps, Division and Training School Battle Simulation Centers.

TITLE: JANUS/R - JANUS/BGWG.

DATE IMPLEMENTED: 1987/1988 respectively.

MODEL TYPE: Analysis.

PROPONENT: BGWG Section, CA4 Division, RARDE Fort Halstead, Kent, England, UK.

POINT OF CONTACT: I.S. GARDNER, CA4 RARDE Fort Halstead, Kent, UK.

PURPOSE: JANUS/R is a research and evaluation tool that deals primarily with weapon systems development and effectiveness. It can also be used to assess force capability and requirements, dealing with courses of action, mix, effectiveness, and resource planning.

DESCRIPTION:

Domain: Land and air/land.

Span: Local.

Environment: Digitized terrain consists of data for each 50-meter square. Terrain features include spot heights, seven types of vegetation, seven types of buildings, rivers, roads, bridges, and obstacles. The model can handle any time of day in any weather conditions.

Force Composition: Up to brigade level.

Scope of Conflict: Conventional.

Mission Area: Any conventional missions within the domain.

Level of Detail of Processes and Entities: The lowest entities modeled are individual men, vehicles, or aircraft, although men are usually grouped into small teams. Attrition, movement, target acquisition, and logistics are modeled for each entity.

CONSTRUCTION:

Human Participation: Required for decisions, although the model will continue to run without a decision.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Does not model C3I in any detail.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A more detailed mobility model and an increase in the number of mine types are planned immediately. Approximately 30 other changes to be made have been identified.

INPUT: Terrain data, weather data, system and weapon characteristics including attrition data, mobility data and activity timings, and smoke and dust data.

OUTPUT: System status as requested during the game. Records of all direct fire and indirect fire events, mine encounters, and detections can be printed.

HARDWARE AND SOFTWARE:

Computer:	VAX series from microVAX to VAX 8700 with a VMS operating system.
Storage:	100 MB.
Peripherals:	RAMTEK 9400 series graphics device with a 19-inch monitor, a data tablet, a four-button puck, and a key pad; a high-speed line printer; and peripheral VT100 terminals.
Language:	FORTRAN.
Documentation:	N/A.

SECURITY CLASSIFICATION: Code is unclassified and data base as sent is unclassified (there is a classified key).

GENERAL DATA:

Data Base: If the data base is in the file, as most are, it takes minutes. Completely new data bases may take man-weeks.

CPU time per Cycle: Runs at ratio of 1 minute of game time to 3 minutes of real time.

Data Output Analysis: Killer-victim score boards, engagement range analysis, force exchange ratios, and loss exchange ratios.

Frequency of Use: Daily.

Users: RARDE.

Comments: N/A.

TITLE: JANUS(T).

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis (has been used as exercise driver and training model).

PROPONENT: Brigade/Battalion Interactive Simulation Division, Combat Simulation Directorate, TRAC-WSMR, White Sands Missile Range, NM 88002-5002.

POINT OF CONTACT: Mr. C. Lee Kirby, (505) 678-4949, AV 258-4949.

PURPOSE: JANUS(T) is a combat developments tool. It is an interactive, near-real-time model developed to explore the relationships of combat and tactical processes. Players make doctrinal and tactical decisions, deploy forces, develop scenarios, and make and execute plans.

DESCRIPTION:

Domain: Land, air, and sea.

Span: Can accommodate any locale, depending upon data. Normally battalion and brigade operations are conducted.

Environment: Data dependent. Three-dimensional terrain with added information representing roads, rivers, towns, and vegetation. Temperature, humidity, and wind direction are also utilized. Operations can be conducted in daytime, night, or under reduced visibility conditions.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Virtually all weapons found on current or proposed battlefields can be portrayed. Primarily directed towards conventional warfare but has limited chemical portrayal.

Mission Area: Conventional and low-intensity conflict can be represented.

Level of Detail of Processes and Entities: Individual soldier or individual system is lowest entity modeled. Conventional direct fire from both ground and air systems is automatic and dependent on line-of-sight, probability of acquisition, response time, reload rates, range, and posture of firer and of the target. The player has the ability to mount and dismount forces on vehicles. The model also supports detailed play of precision-guided munitions such as COPPERHEAD, HELLFIRE, and FOG-M. Obstacles, natural and man-made, are represented as are smoke, artillery dust, plus radar and conventional optical and IR sensors. Chemical alarms and performance degradation due to MOPP have been incorporated. Conventional mines plus air, ground, and artillery-delivered scatterable mines are played in detail including the capabilities to breach, bull, or bypass these obstacles.

CONSTRUCTION:

Human Participation: Required to make a number of game decisions.

Time Processing: Dynamic, event-sequenced model.

Treatment of Randomness: All elements of ground, air, and sea combat are treated stochastically. Outcomes of events occur according to the laws of probability and change.

Sidedness: Two-sided, asymmetric model with both sides reactive.

LIMITATIONS: Area fire of direct fire weapons is not assessed, illumination rounds are not played; and nuclear phenomena such as dazzle, induced radiation fallout, and EMI effects are not currently assessed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: An interactive MOUT capability, heterogeneous aggregation of forces, and the ability to run the model in a systemic mode are currently being worked upon. Additional enhancements to "smart" weapons capabilities and to automatic functions, such as dismounting, are planned for addition to the model.

INPUT: Phenomenology data types for weapons characteristics and effects, sensor characteristics, mine characteristics, flyer and radar data, terrain information, and forces information are all required inputs to the model.

OUTPUT: Produces a hardcopy output of game statistics, artillery summaries, direct fire reports, range analyses, detection tables, and killer-victim scoreboards. Also provides a graphical replay and rerun capability.

HARDWARE AND SOFTWARE:

Computer:	VAX computer with a VMS operating system.
Storage:	5 MB central memory and 456 MB mass storage.
Peripherals:	Two RAMTEK 946X or two Tektronix 4125 workstations (proliferation package has four RAMTEK workstations), one graph tablet and puck per workstation, one printer, one VT-220 per workstation.
Language:	VAX-11 FORTRAN.
Documentation:	JANUS(T) documentation published June 1986.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Creating a data base from scratch, when data is available from data sources, requires approximately two weeks to build and check. For normal study requirements, when only data base modifications are necessary, approximately two days are needed.

CPU time per Cycle: N/A.

Data Output Analysis: Postprocessor, hardcopy and graphics, aids in analysis of output. Analysis of each game requires approximately 1/2 hour.

Frequency of Use: Varies by user, but is used at least several times per year by those users listed below.

Users: TRAC-WSMR, TRAC-FLVN, Ft. Benning, Ft. Knox, Ft. Rucker, Ft. Sill, TRAC-MTRY, RAND, RARDE (UK).

Comments: Continually upgraded based upon requirements and priorities established by study proponents. TRAC-WSMR is configuration control agency and the model is managed through a Model Resources Group chaired by HQ, TRAC.

TITLE: JAWS - Joint AFSC Wargaming System.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Training and education.

PROPONENT: National Defense University, Armed Forces Staff College, 7800 Hampton Boulevard, Norfolk, VA 23511-6097.

POINT OF CONTACT: LTC David Feigel, (804) 444-5320, AV 564-5320.

PURPOSE: JAWS is used primarily to test the student's TFTRL and operation plans. It serves as a deployment and employment exercise driver with an operations support and a force capability assessment focus for various mixes of forces and resources.

DESCRIPTION:
Domain: Land, sea, air, and logistics deployment and employment at about equal resolution.

Span: Theater to small region depending on selected scenario and the attendant data base.

Environment: Hex-based. Two of 22 discrete terrain and transportation factors must be chosen for each hex. Models day and night operations and different degrees of weather constant throughout the theater. Models various size roads, rivers, and transportation barriers.

Force Composition: Joint and combined forces; Blue and Red.

Scope of Conflict: Conventional weapons including "smart munitions."

Mission Area: Conventional; AFSC scenarios emphasize joint task force deployments and employments.

Level of Detail of Processes and Entities: The players give orders to units to initiate activities. Certain processes, such as air defense or withdrawal, are activated automatically. All attrition results are based on Lanchester coefficients. Air and naval engagement events are based on probability of detection and successful engagements using Monte Carlo techniques. Suspense lists are maintained to control discrete events and processes.

CONSTRUCTION:
Human Participation: Required for making decisions and subsequent issuing of orders and instructions for major units.

Time Processing: Processes and pending events occur at a controller-specified ratio of exercise time to real clock time. Games may be conducted at speeds equal to or faster than real clock time.

Treatment of Randomness: Land attrition deterministically based on Lanchester coefficients. Air, naval, and convoy attrition assessed through a combination of Lanchester coefficients and Monte Carlo techniques.

Sidedness: Two-sided, asymmetric, reactive. Red can be run in a partial automatic mode. Control can override most events or processes.

LIMITATIONS: Aggregated level of detail for land, sea, air, and logistics operations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The air module was significantly upgraded in early 1991. Plans have been made for similar upgrades to the land and sea modules. Red logistics constraints, graphical interfaces, an air tasking order generator, and improved targeting techniques are being planned.

INPUT: Orders from players and control via terminals or PCs; scenario data base.

OUTPUT: Printouts of movement, attrition, intelligence, and logistic information as well as summary statistics.

HARDWARE AND SOFTWARE:

Computer:	IBM, VAX, or CDC mainframes; IBM, VAX, or Perkin-Elmer minis; or PRIME (UNIX) micro-computers with 8 MB RAM.
Storage:	At least 30 MB of disk space is desirable.
Peripherals:	Minimum game configuration consists of three printers for output (Blue, Red, and Control) and three terminals or PCs for order input.
Language:	ANSI standard FORTRAN 77.
Documentation:	Four programmer manuals and three player manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Depending on size, a new scenario can take from one to eight person-weeks to develop. An automated program (PBASE) is available to assist in data base development.

CPU time per Cycle: For an IBM 3090/600 application, approximately 1.2 CPU seconds per cycle.

Data Output Analysis: End-of-game statistics. Games can be rerun from archived, time-tagged order input files.

Frequency of Use: Four game sets of 12 games each per year (48 games).

Users: AFSC, NDU-INS-WGSC, WPC, and Vector Research, Incorporated (VRI), 901 South Highland Street, Arlington, VA 22204.

Comments: Source code maintained at NDU-INS-WGSC, AFSC, and VRI.

TITLE: JC3S - Joint C3 Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Joint Director of Laboratories (JDL), Technical Panel for C3.

POINT OF CONTACT: Mr. J. Tremlett, RADC/CO-1, (315) 330-7285, AV 587-7285.

PURPOSE: JC3S is a research and evaluation tool that deals with systems development and effectiveness. It provides enhancements to the RESA model that includes more representative modeling of air and land component forces, terrain features, and their interactions.

DESCRIPTION:
Domain: Air, land, sea, and undersea.

Span: Accommodates any theater depending on data base; terrain feature and land forces data bases currently available for Central Europe only.

Environment: DTED Level II terrain data base with roads, rivers, cities, political boundaries, and barriers modeled.

Force Composition: Joint forces, BLUE and RED.

Scope of Conflict: Primarily conventional warfare (RED and BLUE), limited electronic combat, and very limited nuclear and chemical effects possible.

Mission Area: Conventional naval mission areas modeled in RESA augmented by air interdiction, close air support, and other air-land battle conventional missions.

Level of Detail of Processes and Entities: Ground units currently modeled at the battalion level. Aircraft flights modeled individually. Surface and subsurface platforms modeled. Ground unit movement currently road-constrained. Off-road movement is being implemented. Detection and identification of enemy units model utilizes line of sight, range, and target cross section. Engagement outcome determined by rules of engagement, weapons payload, and attrition models. Logistics and communications are modeled.

CONSTRUCTION:
Human Participation: Not required, but when used for decisions and processes it significantly enhances realism.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Visual and radar detection models and damage model are deterministic. See RESA description for other models.

Sidedness: Two-sided, symmetric, reactive.

LIMITATIONS: Geographic and forces data bases for land forces limited to Central Europe. Scenario complexity limited by processor memory and speed. Off-road movement model and force-on-force engagement modeling limited.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expanded data bases for theaters worldwide, ground movement, and engagement model enhancements.

INPUT: Scenario input requirements include unit definitions, initial deployment positions, destinations, and other actions to be taken (initial orders).

OUTPUT: Produces graphic display of scenario activity and movement, numerous alphanumeric status boards for RED and BLUE units, and event data files suitable for post-game analysis. Postprocessor available to help analyze output.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX series of computers with VMS operating system V4.7 or higher.
Storage:	400,000 blocks disk storage required for source, executable, scenario, and cartographic data.
Peripherals:	Tektronix 4125 Color Graphic Display, and VT100 (or equivalent) alphanumeric terminals.
Language:	Rational FORTRAN (RATFOR) and some Pascal.
Documentation:	Software design document, software product spec, software user's manual, technical report (also see RESA).

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Weeks or months, depending upon scenario scope.

CPU time per Cycle: Depends on number of entities, complexity of scenario, and number of players. Can be in excess of 30 minutes processing time for 3 minutes elapsed in scenario on small VAX processor.

Data Output Analysis: Postprocessor assists in analysis of recorded events.

Frequency of Use: Data not yet available, but frequency of use anticipated to be several times per year.

Users: NOSC Code 454, U.S. Army CECOM AMSEL-RD-C3-AF, and RADC/CO.

Comments: JC3S derived directly from RESA and DGTS models.

TITLE: JECEWSI - Joint Electronic Combat Electronic Warfare Simulation/JEWC.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and education.

PROPONENT: Force Modeling Division, Computer Applications Directorate, Joint Electronic Warfare Center, San Antonio, Texas 78243-5000.

POINT OF CONTACT: LTC Boyus/CAPT Munn, DSN 969-2579, Commercial (512)97[illegible]-2579.

PURPOSE: JECEWSI is an exercise driver for command post exercises designed to focus on the electronic combat environment in support of tactical air and air defense operations. The model quantifies the effects of EW systems on the outcome of the training scenario. The model is currently interfaced with the standard Air Force training simulation, the Air Warfare Simulation System (AWSIMS). JECEWSI has the following capabilities: Stand-off and self-protect jamming against radars and communications; models an integrated air defense system (IADS) and ability to degrade the LADS; and, has a graphics display to show the IADS net and link structure with jamming effects.

DESCRIPTION:

Domain: Land and Air.

Span: Accommodates scales from individual up to theater depending on degree of complexity in data base development.

Environment: Uses smooth curved earth. Capability exists to add digitized terrain.

Force Composition: Considers mix of forces from the system level to the combined forces level, Blue and Red.

Scope of Conflict: Conventional weapons, Blue and Red.

Mission Area: Tactical air operations for stand-off and self-protect jamming against radars and communications; realistic electronic environment for radars and communications including actual equipment capabilities, operational networking, processing factors, transmission times, ECM and ECCM; integrated air defense system (IADS) with complete command, control and communications (C3) structure with networks and links and ability to degrade IADS C3 structure; ground to air communications through ground control intercept (GCI) and ability to degrade GCI communications.

Detail of Level of Processes and Entities: The user describes both the friendly and threat radar, communication and jamming system parameters, unit types and aircraft. Next, the user establishes a command control and communications structure by creating a link and net structure for the IADS and GCI. JECEWSI is directly interfaced with AWSIMS and reacts to the operation of AWSIMS. JECEWSI maintains a mirror image data base of the order of battle and status of entities played in AWSIMS and is updated by AWSIMS each cycle time (usually every one minute). Players interface with AWSIMS and conduct activities through AWSIMS like launching and flying aircraft for CAS, BAI and support jamming missions. JECEWSI has a direct interface to AWSIMS and plays the electronic environment by doing the following: maintains locations on entities being played; evaluates the geometry among systems (line of sight between jammers and radars/comm systems), calculates the jammer to signal ratio and jamming effectiveness using accepted engineering equations for radar and communications propagation and passes degrades for probabilities of acquisition, launch, kill and degrades for C3 effectiveness to AWSIMS. AWSIMS uses the degrades in the attrition equation to resolve the outcome of engagements. The simulation allows the user to realize and analyze the effects of EW on the outcome of the battle using attrition as the basic measure of effectiveness.

Construction:
Human Participation: JECEWSI is fully automated human participation is not required.

Time Processing: Dynamic, time-stepped.

Treatment of Randomness: Resolution of electronic warfare is deterministic based on employment of radar and communication propagation equations.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Currently smooth curved earth, no environmental factors such as weather.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of DMA digitized terrain elevation data, conversion of graphics to X-windows, data preprocessors, analyst manual and postprocessor capabilities. Additionally, work is underway to add ground EW capabilities to the Army standard training simulation, the Corps Battle Simulation (CBS).

INPUT: Communications, radar and jamming equipment parameters; air defense, GCI, communication unit and aircraft configurations; combat and communication organization.

OUTPUT: Degrades for probability of aircraft acquisition, launch and kill; and C3 effectiveness degrade. Degrades are passed to AWSIMS; AWSIMS uses JECEWSI degrades in the attrition equation; graphics output on JECEWSI graphics terminal showing status of IADS and GCI nets and links; graphics output on AWSIMS terminal showing status of radar systems; attrition of aircraft as a function of EW system employment.

HARDWARE AND SOFTWARE:

Computer:	JECEWSI on DEC VAX under VMS operating system networked to AWSIMS on DEC VAX and to JECEWSI graphics on SUN 3/60 workstation using DECNET. JECEWSI graphics currently uses SUNVIEW.
Storage:	5,000 blocks for a theater level scenario.
Peripherals:	Printer.
Language:	SIMSCRIPT II.5 and C.
Documentation:	Source code, fully commented; design document.

SECURITY CLASSIFICATION: Unclassified, however data bases are often classified.

GENERAL DATA:
Data Base: Usually 2-8 weeks depending on level of complexity; however, model users have done scenario development, sharing of these files can decrease data base preparation time significantly.

CPU time per Cycle: Run in real time.

Data Output Analysis: History file available.

Frequency of Use: Varies by command, used at least four times a year by those listed in the next paragraph.

Users: Joint Electronic Warfare Center, Warrior Preparation Center, 4441 Tactical Training Group (Blue Flag).

Comments: Configuration control by JEWC with an established Users Group as listed above. Upgrades are done based on priorities, funding and consensus of the Users Group.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: JFAM/EW - Joint Force Analysis Model/Electronic Warfare. (Formerly known as the Divisional Electronic Warfare Combat Model (DEWCOM)).

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Force Modeling Division, Computer Applications Directorate, Joint Electronic Warfare Center, San Antonio, Texas 78243-5000.

POINT OF CONTACT: MAJ John R. Ferguson, DSN 969-2579, Commercial (512) 977-2579.

PURPOSE: JFAM/EW is a research and evaluation tool designed to focus on the electronic combat environment in support of tactical ground and air operations. The model will do the following: analyze communications, EW and air defense employment concepts, assess system/force mix, examine interoperability issues, conduct combat and support force trade-offs, examine joint and combined warfare issues and interface with field test excursions.

DESCRIPTION:

Domain: Land and air; limited naval operations.

Span: Accommodates scales from individual up to theater depending on degree of complexity in data base development.

Environment: Uses Defense Mapping Agency (DMA) digitized terrain elevation data (DTED) for terrain relief and DMA WDB2 for feature data. Weather and time of day are considered in the play of air forces and air defense systems.

Force Composition: Considers mix of forces from the system level to the combined forces level, Blue and Red.

Scope of Conflict: Conventional weapons, Blue and Red.

Mission Area: Conventional missions to include: tactical ground operations; tactical air operations for close air support, interdiction, defense suppression, support jamming in stand-off and self-protect modes; use of RPVs in a lethal or non-lethal mode; resupply; realistic communications environment, including actual equipment capabilities, operational networking, processing factors and transmission times; ground and airborne EW operations include jamming, deception, interception and direction finding vs. communication or radar systems; intelligence gathering and dissemination among units; air defense networks, including firing elements, control centers, early warning radars and complete command and control structure.

Detail of Level of Processes and Entities: The user describes both the friendly and threat forces to include infantry, armor, artillery, air defense artillery, EW units, support units and air forces at a variable resolution from individual level or at some aggregate level. Next, the user establishes a command control and communications structure by creating a link and net structure. Last, the user issues the forces a set of orders with stimulus for ground movement which include: attack, defend, delay, withdraw or move; air task orders for air forces specifying targets to attack; communications orders for routing of message traffic and EW orders for the operations of jammers, interceptors, locators and counter-battery radars. The simulation allows the user to analyze the effects of EW on the outcome of the battle using attrition as the basic measure of effectiveness. Direct and indirect fire attrition is based on combat values assigned by weapon system and use of modified Lanchester equations. Air and air defense attrition is based on probabilities of damage and kill and using Monte Carlo techniques. Ground warfare and logistics are modeled at low resolution. Communications, electronic warfare, air warfare and air defense are all modeled at high resolution.

CONSTRUCTION:

Human Participation: Not required, however the model is interruptable so scheduled changes can be incorporated interactively.

Time Processing: Dynamic, time- and event-stepped.

Treatment of Randomness: Air and air defense attrition stochastically based on computation of probability of damage and kill with Monte Carlo determination of result. Ground attrition deterministically based on modified Lanchester equation.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Does not model naval operations like ship-to-ship fighting, naval mine warfare or undersea operations, however, does model naval air and gun support and naval air defense systems.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhance direction finding, ground and air maneuver to higher resolution; develop fully automated relational data base management system with graphical preprocessors for scenario construction; air-to-air, chaff and flare capability, more detailed postprocessor support, analyst manual.

INPUT: Weapons, communications and EW equipment, units, terrain, combat and communication organization, tactical, communication and EW orders, avionics, aircraft, corridors, air operations orders, air defense systems and organization, infrared and radar cross section patterns, airborne jammer characteristics, RPV characteristics, SEAD data tables and attrition tables.

OUTPUT: Dynamic graphics display of scenario activities showing ground and air unit movement, display of communications net and links with dynamic status of communications and jamming; status of units at interrupts; formatted records of input data; reports on the status of units, links, messages, equipment, EW operations, intelligence logs, attrition summaries, air and air defense statistics; formatted records of every scenario event.

HARDWARE AND SOFTWARE:

Computer:	VAXStation3100 under VMS operating system, SUN Sparcstation and Silicon Graphics workstations under the UNIX operating system; portable to any system with a SIMSCRIPT II.5 and SIMGRAPHICS compiler.
Storage:	100,000 blocks for a theater level scenario.
Peripherals:	Printer.
Language:	SIMSCRIPT II.5 and SIMGRAPHICS.
Documentation:	Source code, fully commented, in five volumes; executive summary, users manual, operators manual, programmers manual, instructors manual.

SECURITY CLASSIFICATION: Unclassified, however data bases are often classified.

GENERAL DATA:

Data Base: Usually 1-6 months depending on level of complexity; however, members of users group have done scenario development, sharing of these files can decrease data base preparation time.

CPU time per Cycle: Usually one hour of CPU time for every two hours of combat in a division level scenario (on a VAXStation 3100, one MIP machine; faster on other machines). Playing air and air defense increases CPU time significantly because of high resolution.

Data Output Analysis: Dynamic graphics display of scenario activities showing ground and air unit movement, display of communications net and links with dynamic status of communications and jamming; status of units at interrupts; printed reports on the status of units, links, messages, equipment, EW operations, intelligence logs, attrition summaries, air and air defense statistics; formatted records of every scenario event. The Quick Query Output file contains records of all simulation activities, using code numbers as a key, specified by the user.

Frequency of Use: Varies by command, used once a year by those listed in the next paragraph.

Users: Joint Electronic Warfare Center, Joint Warfare Center, Combat Developments Fort Bliss, USACECOM C2SW, Combat Developments Fort Huachuca, ARMTE White Sands.

Comments: Configuration control by JEWC with an established Users Group as listed above. Upgrades are done based on priorities, funding and consensus of the Users Group.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: JPLAN - Joint Planning Exercise/RADEX - Rapid Deployment Exercise.

DATE IMPLEMENTED: February 1988.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: JPLAN and RADEX, seminar exercise drivers and support deployment planning exercises. Each exercise highlights the complexities and problems associated with planning the deployment and sustainment of large force packages over long distances. Players apply basic JOPS concepts in developing a force list within the constraints of limited lift and port capabilities. Players assign movement, timing, and priority. A transportation feasibility estimator (TFE) provides feedback on the feasibility of their plans within established constraints.

DESCRIPTION:
Domain: Deliberate Planning Cycle and Crisis Action System of the JCS. RADEX provides for deployment both by airlift and sealift. JPLAN provides only airlift.

Span: Theater level.

Environment: Global movement from CONUS to theater of operations.

Force Composition: JPLAN and RADEX portray deployment of joint forces by both the Military Airlift Command and Civilian Reserve Air Fleet. RADEX adds sealift as a deployment method.

Scope of Conflict: Conventional response to theater crisis.

Mission Area: JPLAN and RADEX focus on force and deployment planning. They model strategic airlift and sealift (RADEX only) and CRAF.

Level of Detail of Processes and Entities: Deployment units are of squadron size or larger. Certain specialized units may deploy in smaller units. The user may adapt the model for smaller units.

CONSTRUCTION:
Human Participation: Required for decisions and processes only. Players must make decisions before running the simulation.

Time Responses: Static.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: JPLAN/RADEX do not model geography. Airlift is one sortie/one day regardless of actual distance. Sealift (RADEX only) uses reasonable sailing times. Numbers of air bases, seaports, lift platforms and units deployed are restricted by the hardware environment (i.e., disk capacity and memory).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Data base includes UTC and UTC data, air base and air base limitations, and airlift aircraft and aircraft limitations. For RADEX only, the data base includes seaport and seaport limitations and sealift and sealift limitations. Players must input the Unit UTCs requested for deployment and deployment priority, air base priority and seaport priority (RADEX only). Game developers may establish game parameters in consonance with user requirements.

OUTPUT: The TFE supplies several types of printed reports to aid the student in shortfall resolution. In all, JPLAN and RADEX provide up to 40 different reports to aid in transportation planning and shortfall resolution.

HARDWARE AND SOFTWARE:

Computer (OS):	IBM-compatible MS-DOS machine with 10 megabytes hard-disk drive storage and 640 kilobytes random access memory (minimum 2 megabytes recommended). Also requires the INGRES PC data base management system run-time environment.
Storage:	Requires 7.8 megabytes for executable and 1.5 megabytes for disk work space.
Peripherals:	Monochrome monitor (color optional) and printer.
Language:	MS-C, SQL and the INGRES 4GL.
Documentation:	User and Maintenance Manuals available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Usually played as part of a 5-day exercise.

Data Base: Up to 10 man-weeks for complete data base change.

CPU time per Cycle: Not applicable.

Data Output Analysis: Performed by players.

Frequency of Use: Annually, by respective users.

Users: Air Command and Staff (JPLAN) and Air War College (RADEX). AUCADRE and AFWC have used variations.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: JTIDSC2 - Joint Tactical Information Distribution System Class 2 Terminal Network Simulation Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds
ATTN: [STEEP-(T-E)], Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Mr. Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: The JTIDSC2 model is an operational support tool (decision aid). It is used to estimate the communication performance of JTIDS networks when deployed in the complex electromagnetic environments expected to occur in tactical situations, including the performance under various conditions of deployment geometry and threat characteristics.

DESCRIPTION:
Domain: Land, air, and limited space and naval.

Span: Accommodates any theater depending on data base. Can model individual equipment to full corps and above deployments.

Environment: Detailed RF phenomenology model. Models the effect of terrain and ground constraints in either an area prediction or point-to-point mode. Options are available to use DMA digitized terrain data as input. Effects of time of day, month, and climatology considered for various propagation models.

Force Composition: Joint and combined, BLUE, GREY, and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: JTIDSC2 uses deployment data concerning the location, terrain, and required linking of communications and electronics equipment contained in a tactical force. System processes that are modeled include packet initialization, message packet reception, receive and process acknowledgement packet, send message packet, and transmission failure.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, containing both Monte Carlo and direct computation processes.

Sidedness: Not applicable.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Propagation modules are under study for enhancement plus computer graphical development for file updates, data validation, and model output presentations.

INPUT: Tactical deployment data, equipment technical performance characteristics, propagation path loss parameters, and message traffic data.

OUTPUT: Message error rate/throughput for test system terminals, message transmission times, and message failure statistics. Output data presentations suitable for statistical postprocessing.

HARDWARE AND SOFTWARE:

Computer:	CYBER 180 Model 830.
Storage:	Variable; requirements can be adjusted.
Peripherals:	Optimum number of disk and tape drives varies; variable mass storage requirements in size of data files determine requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires one year. Analysis requiring data modification for specific test system requires one or two months depending on system.

CPU time per Cycle: Depends on deployment size and number of equipment to be evaluated. Corps-size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts, disk, and files.

Frequency of Use: Last analysis performed in 1986.

Users: USAEPG. Numerous analyses have been performed for a variety of government agencies.

Comments: The model is not machine dependent. It does, however, take advantage of the CDC CYBER 60-bit word for optimizations of data storage and access, and would require modification for other environments.

TITLE: JTLS - Joint Theater Levol Simulation.

DATE IMPLEMENTED: 1983, with continuous functional upgrade since then.

MODEL TYPE: Analysis.

PROPONENT: Joint Warfare Center, Hurlburt Field, FL 32544.

POINT OF CONTACT: Major Bernie Wisthoff, (904) 884-7355, AV 579-7355 and LCDR N.L. Deitch, (J-8), (703) 695-1762; AV 225-1762.

PURPOSE: Primarily to analyze theater-level operations plans. Designed as operations support and force capability tool for evaluating different mixes of forces or resources; also provides high-resolution play for exercises and seminar wargames.

DESCRIPTION:
Domain: Land, air and limited naval operations with full intelligence and logistics capabilities.

Span: Unit data bases exist for Korea, Central America, Europe, Southwest Asia, and the Caribbean basin. Graphics utilization limited by the availability of video data. Video disks exist for Caribbean basin, Southwest Asia, Central America, Europe, Korea and Japan. SUN graphics data exist for Southwest Asia.

Environment: Hex-based, usually 16.5 or 7.5 km hexes. Hexes may vary in size between data bases, but not within one data base. Hex characteristics include trafficability, elevation, roads, and chemical or nuclear contamination. JTLS models railroads, rivers, and transportation barriers; time of day; and three different degrees of weather.

Force Composition: Joint and combined forces, RED and BLUE.

Scope of Conflict: Single Corps to theater. Primarily conventional, although limited nuclear and chemical effects possible.

Mission Area: Conventional air, ground, and naval missions; effects of special operations can be modeled.

Level of Detail of Processes and Entities: Data base defines unlimited number of combat systems and types of supply; and up to 13 unit sizes. Ground attrition based on mixed heterogeneous Lanchestrian formulation, with coefficients modified by environment, terrain and allocation of resources. Losses periodically assessed against units, with the period based on the data. Air-to-air, surface-to-air, and air-to-surface attrition assessed by probability of kill: output is individual kills of aircraft and other items. Missions composed of single sorties, multiple aircraft, or multiple packages, all dynamically requested during scenario execution. Naval ships modeled as individual units. Attrition is based on remaining vulnerability compared to number of hits taken. Amphibious operations are explicitly modeled. Resupply is accomplished by truck, rail, barge, pipeline, or air.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-step; user-specified ratio of exercise time to real time.

Treatment of Randomness: Ground combat attrition deterministic. Air and naval attrition stochastic, based on direct computation of probability of detection and kill: Monte Carlo results determination.

Sidedness: Two-sided, asymmetric (both sides are interactive).

LIMITATIONS: Does not model undersea operations; Special Operations, or land-based cruise missiles.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Postprocessor function being developed. Upgrade for SUN graphics including automated tool to convert DMA CD-ROM data to required format scheduled for early FY92. ATO generator, land-based cruise missiles, Special Operations, stochastic weather, limited underwater warfare, and ability to execute over a Wide Area Network scheduled for release mid-FY92. There is a continuous upgrade to the functions represented, with a new release of the model each year.

INPUT: Recognizes relevant terrain, weapons, movement, attrition tables, unit characteristics and TPFDD information as input. No hard-wired data items.

OUTPUT: Interactive Information Management Terminal status boards and printouts of movement, attrition, intelligence, logistics data, and unit status.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX 8600 series, using the VMS operating system; Microvax II operation is possible.
Storage:	240,000 blocks (122 megabytes) needed in addition to data base installed.
Peripherals:	Minimum requirements: 1 printer, 1 graphic suite, and 5 player terminals. VT 100/220/320 terminal compatible.
Language:	SIMSCRIPT II.5, "C", DCL, and INGRES.
Documentation:	Extensively documented with 13 published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Complex, time-consuming development process, due to the extensive information required. Six to eight months is common for a new data base.

CPU time per Cycle: Dependent on data base size, scenario complexity, and hardware configuration. System goal is execution at four times real time.

Data Output Analysis: Produces hardcopies of raw data.

Frequency of Use: Varies by command.

Users: USLANTCOM, USCENTCOM, USEUCOM, USSOCOM, USSOUTHCOM, Joint Warfare Center, SHAPE Technical Center, WPC, NDU, AUCADRE, Army War College, Naval postgraduate School, and Combined Forces Command/Korea.

Comments: A configuration board (made up of representatives of all users) manages model and establishes priorities for model enhancement.

TITLE: Kinematics.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education (support of war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: Kinematics displays user-specified geographical areas and keeps track of user-specified ship and formation movement and fuel usage. It is designed to provide graphic support for seminar war games.

DESCRIPTION:
Domain: Land and sea.

Span: Regional.

Environment: Geographic depiction of land and sea boundaries.

Force Composition: BLUE and RED naval forces.

Scope of Conflict: No conflict.

Mission Area: None. Shows geographic location of forces.

Level of Detail of Processes and Entities: Displays ships, formations, land and sea borders, and seaports. Moves ships and formations in user-specified time-steps according to user input of movement plans.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: User input-intensive.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Geographic area, seaport location, ship and formation specification, movement plans, and fuel status.

OUTPUT: Graphic display of ship and formation locations. reports of location, and fuel usage and availability.

HARDWARE AND SOFTWARE:
Computer: IBM-compatible PC with 512K RAM and dual 360K floppy drives.
Storage: N/A.
Peripherals: Printer (program will not run without printer).
Language: "C."
Documentation: User's manual, design description, and source code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: One hour for moderately detailed scenario.

CPU time per Cycle: 10 seconds.

Data Output Analysis: None.

Frequency of Use: None to date.

Users: Wargaming Department, Naval War College.

Comments: Kinematics is designed to be used in conjunction with the Strike and Surface-Air Battle models. Data bases are compatible. User should be able to move freely among all three models. Kinematics alone is merely a device to administratively keep a plot of ship locations.

TITLE: LABS - Local Air Battle Simulation.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: McDonnell Douglas Corporation, McDonnell Aircraft Company, P.O. Box 516, St. Louis, MO 63166.

POINT OF CONTACT: Stephen L. Chan, (314) 233-8283 or Barbara J. Vogel, (314) 777-7310.

PURPOSE: LABS is a research and evaluation tool that simulates air-to-air combat with up to 24 aircraft applying different tactics to a variety of missions. It also evaluates the effectiveness of variations in the design of aircraft, air weapons, and avionics.

DESCRIPTION:
Domain: Air.

Span: Local through mission level.

Environment: All altitudes, clouds, clear weather, ECM, and no-ECM.

Force Composition: Up to 24 fighters and bombers in raids and defensive elements.

Scope of Conflict: Conventional warfare.

Mission Area: Beyond visual range through close-in air-to-air combat.

Level of Detail of Processes and Entities: Entities include aircraft, missile, gun, radar, sensor, other electronic systems, and pilot. Processes include aircraft and missile flight, propulsion, and control; C3I and multiple sensor integration; pilot risk; and attrition.

CONSTRUCTION:
Human Participation: Interactive mode requires human participation for pilot decisions. Model waits for human responses. Batch mode does not require on-line participation, but uses predefined tactics and rules.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Choice of stochastic (Monte Carlo) or deterministic (expected value approach).

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: 24 aircraft, 10 types.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Real-time operations and expert system applications.

INPUT: Weapon system definition data:

- Aircraft (aero and propulsion tables, armament types and loadings, infrared (IR) signature tables, maximum-energy climb profiles).

- Radar (antenna gimbal limits, single-scale probability of detection tables, sweep rate and bar spacing, and antenna pattern).

- Missile (aero and propulsion tables, trajectory profiles, seeker type, seeker limits).

- ECM (jammer type and power and pattern).

- Tactics (maximum acceptable loss rate, attack altitude profile, disengagement altitude profile, load factor for attack and disengagement, and radar scan setting).

Initial flight states and geometry:

- Number of aircraft.
- Position.
- Speed.
- Heading.

Termination condition (currently time limit).

OUTPUT: Summary of engagement outcomes, event ledger (time history of key events), graphical display of aircraft and missile flight path, and graphical display of selected state variable time histories.

HARDWARE AND SOFTWARE:
Computer(OS): DEC VAX (VMS), CDC CYBER 175/176 (NOS).
Storage: VAX: 1 MB. CDC: 350 K8 words.
Peripherals: Tektronix 4014/4016 terminal and 4631 hardcopy unit.
Language: FORTRAN.
Documentation: Local Air Battle Simulation (LABS) Users Manual, January 1982, and annual IRAD project descriptions.

SECURITY CLASSIFICATION: Unclassified and secret versions.

GENERAL DATA:
Data Base: Approximately one week.

CPU time per Cycle: 1 CPU minute per minute of battle for two versus four engagement (1 MIP machine).

Data Output Analysis: Approximately one day.

Frequency of Use: Used daily.

Users: McDonnell Douglas, USAF OT&E Center, ASD, AFWAL, and DARPA.

Comments: N/A.

TITLE: LATE.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill High, ITT Avionics, (201) 284-2870.

PURPOSE: The purpose of this program is to generate a specific threat environment geometry.

DESCRIPTION: It scans an entire Multi-Spectral Force Deployment (MSFD) file for selected threats and creates a file containing the required geometry and parameters.

INPUT: MSFD data file, list of desired threats, lat/long window (if desired).

OUTPUT: One file containing the desired MSFD subset, a plot data file containing the threat geometry on a per threat basis (for offline map plots).

HARDWARE AND SOFTWARE:
Computer: DEC VAX.
Storage: 30M Bytes (up to 2x size of MSFD); memory req: 4M Bytes.
Language: FORTRAN 77 (VAX).
Documentation: Sample data files.

SECURITY CLASSIFICATION: Code is unclassified; input data is secret.

GENERAL DATA:
Data Base: Typical data: 5 minutes.

CPU time per Cycle: 30 minutes on VAXstation 3100.

Usage: Used to create threat laydowns for the INSSIM and CMUES programs.

Comments: This program can generate threat environments for a host of campaign and mission simulations.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: LDM - Logistics Decision Model.

DATE IMPLEMENTED: January 1989.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Logistics Evaluation Agency,
ATTN: LOEA-PL, New Cumberland Army Depot, New Cumberland, PA 17070-5007.

POINT OF CONTACT: Dr. L.P. D'Amato, (717) 770-7995, AV 977-7995.

PURPOSE: The LDM supports the U.S. Army's logistics planning, programming, and budgeting efforts by measuring the effect of Army logistics resource decisions in terms of combat outcomes.

DESCRIPTION:

Domain: Land.

Span: Theater.

Environment: Nonspecific.

Force Composition: Combined land forces.

Scope of Conflict: Conventional.

Mission Area: Theater land combat and logistics mission areas, including transportation, receipt and issuance of supplies (POL, AMMO, etc.), and maintenance of equipment.

Level of Detail of Processes and Entities: Models combat at the theater level and individual logistics functional areas at each theater echelon. Weapons categories include tanks, armored personnel carriers, and infantry. Logistics process include transportation, receipt and issuance of supplies (POL, AMMO etc.), and maintenance of equipment.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Combat is aggregated to the theater level. Logistics is aggregated to mission areas at each theater echelon. Data must be available from a larger, more detailed, combat simulation model, such as the Army's Force Evaluation Model or Concept Evaluation Model. LDM must be calibrated to the combat portion of a specific case study with logistics system descriptions and factors derived from standard Army sources, including Force Analysis Simulation of Theater Administrative and Logistics Support results for the study and the Army Force Planning Data and Assumptions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Pre- and postprocessors are being developed to speed up data input and results analysis. These processors will also make LDM accessible to non-ADP expert users.

INPUT: Occurs in two stages. The first extensive effort involves calibrating LDM to a large combat simulation and developing the associated logistics structure. The second simpler stage involves modifications to logistics resources for each variation being analyzed.

OUTPUT: Presently computer files that can be imported into standard software, such as LOTUS and dBASE III+, for analysis. In the future, LDB will also output reports and graphics containing aggregated data.

HARDWARE AND SOFTWARE:
Computer: IBM AT compatible with math coprocessor.
Storage: 2 megabytes.
Peripherals: Printer.
Language: FORTRAN, LOTUS, and dBASE III+.
Documentation: Under development.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: 1 to 4 months.

CPU time per Cycle: 10 to 30 minutes.

Data Output Analysis: From several minutes to several weeks.

Frequency of Use: Extensive during resource decision processes.

Users: HQ Department of the Army, Office of the Deputy Chief of Staff for Logistics, and the U.S. Army Logistics Evaluation Agency.

Comments: LDM is a reproduction model that emulates the combat portion of larger, more detailed combat simulation models. As such, LDM must be calibrated to the combat portion of a specific case study. Logistics system descriptions and factors must be available from the base study or derivable from other sources. LDM represents logistics decrements or increments as changes in the capability of units or the availability of resources. Comparisons of outputs, such as forward line of own troops movement, RED and BLUE personnel losses, and equipment and supplies lost and remaining, give an indication of the effects on logistics resources, capacities, or capabilities.

TITLE: LEGACY - A Land Battle Analysis Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Rockwell International - Tactical Systems Division.

POINT OF CONTACT: David J. Gill, (404) 497-5196,

PURPOSE: LEGACY is a research and evaluation tool for developing and evaluating weapon systems and their contribution to combined arms effectiveness.

DESCRIPTION:

Domain: LEGACY is a land battle model.

Span: Battalion level engagements are represented.

Environment: Terrains of various degrees of roughness are represented using a mathematical model based on digitized terrain and empirically generated mask angle distributions.

Force Composition: Combined arms forces, Blue and Red, exclusive of mortars, machine guns, and small arms.

Scope of Conflict: Conventional

Mission Area: Close combat zone defense and offense

Level of Detail of Processes and Entities: The model represents individual weapon types as two entities: a firing or weapon portion and a platform portion. Each type can have any number of individual units within type, however, these are represented probabilistically and not individually processed. Weapon types may have multiple firing types assigned to them.

Ten weapon types are permitted for each side. Either Blue or Red can be assigned offense or defense. Process is driven by a unique intervisibility model which computes the expected number of targets seen, number of observers with line of sight and duration of sight over time. The model is sensitive to physical correlation, observer/target geometry and organization. Given the sight probabilities, the engagement opportunities within each exchange cycle of a time frame are then processed by representing the kinematics and using standard probability methods.

CONSTRUCTION:

Human Participation: Required. Decisions are developed by tacticians for inclusion at the end of each time frame.

Time Processing: Dynamic; model is closed form within successive equal time-steps.

Treatment of Randomness: Stochastic model is direct computation.

Sidedness: Two-sided, symmetrical in weapon representation, however, forces assigned to offense are constrained to overwatch/bounding maneuvers and defense is constrained to FEBA defense, relative positioning, and retrograde movement.

LIMITATIONS: Ten weapon types per side with unlimited participants per type. Terrain representation requires extensive analysis of digitized terrain to develop intervisibility model. Four terrains are available from smooth to rough.

PLANNED IMPROVEMENTS AND MODIFICATIONS: 1) Inclusion of postprocessor cost analysis to achieve force level cost effectiveness comparison, and 2) Port to PC 386 based computers.

INPUT: Requires development of tactics, terrain, organization of forces and weapon descriptions describing time lines, movement, suppression, reliability, missile flight trajectory, projectile time of flight, probabilities of detection, recognition and kill given shot versus range, rounds available, reload, etc.

OUTPUT: Print/plots score boards containing expected shots fired and number killed for all combinations of weapons for each time frame. Final survival, force exchange ratio, distance where offense is stopped.

HARDWARE AND SOFTWARE:

Computer:	HP9000/200, 300, 400, 500 series computers.
Storage:	10MB disc storage, 4MB RAM.
Peripherals:	Minimum requirements: 1 printer.
Language:	HP BASIC.

SECURITY CLASSIFICATION: Unclassified, but data base is often classified.

GENERAL DATA:

Data Base: Data base is built up over years; and is kept organized by a DBMS specially tailored to facilitate and minimize erroneous input.

CPU time per Cycle: Dependent on CPU and number of weapon types per side. Program generally takes from a few minutes to an hour for one battle.

Data Output Analysis: Postprocessor aids in analysis of output. Produces hardcopies of input and output data. On user option will plot time dependent results.

Frequency of Use: Used regularly by Rockwell and occasionally by the U.S. Army Infantry School. Model has, in earlier forms, been evaluated by U.S. Army TRADOC Analysis Command at White Sands Missile Range and has been presented at MORS (Military Operations Research Society) and ORSA (Operations Research Society of America).

TITLE: LEM - Laser Effects Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: LEM is an analytic computer model of laser degradation in electro-optical (EO) sensors. The model can consider both temporary and permanent degradation effects in a variety of EO and infrared (IR) sensor systems. LEM can model complex optical systems such as rotating and scanning optics, Laser Hardening Optics (LHO) Devices and optical components with multi-layer dielectric thin films. Non-uniform, bidirectional heating of non-homogeneous components can be modeled. The formation of laser-ignited plasmas and their effect on laser propagation and component heating is characterized.

DESCRIPTION: The LEM consists of five modules which perform separate functions within the model. The Optical Analysis module uses raytrace and diffraction calculations to determine the laser irradiance profile incident upon a specified surface in the sensor system. The Thermal Analysis Module uses a 3-D finite element heat conduction model to analyze the laser-induced heating and the phase changes. The Plasma Module determines if a laser-ignited plasma has been formed and models the laser absorption within the plasma and the reradiation of the plasma to the adjacent component. The Effects Module uses the materials data base to update the optical and thermal properties of the materials. These may often vary with temperature and phase. This module also determines the NEI of the system. The Performance Module determines whether or not the user-specified conditions for a system kill have been satisfied. It also calculates the MTF of the optical system and sensor.

INPUT: The LEM accepts input data from card images or disk files. Three types of data files are required for the model. The first file is a variable dimension file which controls the size of the data structures used in the model. This file must be present at compilation time. During compilation, the variable dimension symbolic constants are translated into the corresponding numerical constants. The second file is a data file which must be written prior to execution and assigned to the VAX logical system input. The types of information it requires are as follows:

1. Optical surfaces descriptions, positions, shapes.
2. Simulation inputs.
3. Optical Analysis inputs.
4. Thin film descriptions.
5. System wavefront.
6. Scanning Optics.
7. Laser Hardened Optics.
8. Component/Material descriptions.
9. Thermal Analysis inputs.
10. Relation of Components and Optical surfaces.
11. Fracture input.
12. Detector input.
13. Wavefront inputs for evaluation wavelength.
14. Temperature related inputs.
15. Pulse function inputs.
16. Miscellaneous.
17. Engagement controls.
18. Plasma inputs.
19. System kill criteria.

The third file is the materials data base. The materials data base contains the optical and thermal properties of the materials used in the simulation. The records in the data base are organized sequentially according to the different data formats and have a fixed record length of 80 characters.

Formats and definitions for the three files are described in the Software User's Manual for LEM.

OUTPUT: The LEM creates five different output files. The standard model output is written to Logical Unit 6. Noise equivalent irradiance (NEI) and MTF summaries are written to Unit 9 and 10. Raytrace output is written to the output file specified on Card #3. Output for the graphics routine, LEMONADE, is written to the output file specified on Card #2.

The standard model output begins with an echo of the program input. Next, the Optical Analysis module is called and a summary of the results of this call, including the location and size of the irradiance distribution is given. For each simulation time-step, and each of the components being analyzed by the Thermal Analysis Module, the following information is output:

1. A summary of the Optical Analysis call (if the Optical analysis is repeated for this step.)

2. Pulse data information.

3. Irradiance Distribution into finite element grids as determined by the Thermal Analysis GRIDFIT routine along with peak irradiance (First time-step only).

4. Time-steps used in the Thermal Analysis.

5. The temperature array for each cell in the grid. The X cells are labeled. The Z cells are located along the columns (overlapping may occur to the next line) and the Y cells are located along the rows.

6. Thermal Analysis flags.

7. Detector saturation outputs.

8. NEI outputs.

At the end of the simulation the system kill rule results are output.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780 VMS, CRAY X-MP COS.
- Storage: VAX - 6,134,784 bytes. NOTE: Memory requirements depend on the array sizes set up in the variable dimension file.
- Language: VAX: FORTRAN 77; CRAY X-MP CFT77.
- Documentation: User's Manual; Laser Effects Model Upgrades.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:
Time Requirements: Compilation Time: 368.66 seconds VAX 11/780; Typical Run Time: 8426.30 seconds VAX 11/780 (run time varies greatly).

Users: BDM Corporation; Northrop; DSD, SAIC; WL/AAWW-3.

TITLE: LFMD/AMIP - Logistics Functional Model Development for Army Model Improvement Program.

DATE IMPLEMENTED: TBD.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Mr. Billy Williams, (804) 734-5640-3449, AV 687-5640/3449.

PURPOSE: LFMD/AMIP will be used primarily as a combat development tool to examine new doctrine and competing strategies. It will provide the Army with a capability to 1) assess the impacts of combat on logistics and logistics on combat; 2) perform better force design trade-off analyses while assessing supportability and sustainability risks; 3) provide more credible and auditable planning factors; 4) better assess the benefits and costs of alternative reliability and maintainability hardware specifications; and 5) better compare and evaluate proposed logistics doctrine, organization, and materiel.

DESCRIPTION:

Domain: Land and air.

Span: Corps/Division.

Environment: Will model day and night operations; weather conditions; and terrain including rivers, mountains, roads, and cities.

Force Composition: Will model a mixture of air and land forces in accordance with AirLand battle doctrine.

Scope of Conflict: Conventional, chemical, rear-area.

Mission Area: All conventional combat and combat support missions except unconventional warfare.

Level of Detail of Processes and Entities: Lowest entity to be modeled is a unit, typically a maneuver unit of battalion size. Weapon systems are to be modeled as part of the unit entity. Processes include attrition of air and land forces based on Lanchester equations, consumption of commodities (fuel, ammunition, subsistence), resupply of commodities (including emergency air resupply), and maintenance/medical functions.

CONSTRUCTION:

Human Participation: Not required--interruptable and scheduled changes.

Time Processing: Dynamic, event-step, but uses time-steps for scheduling some actions.

Treatment of Randomness: Basically deterministic; outcome of combat is determined via Lanchester equations.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model in planning stage and currently on hold.

INPUT: Forces and supply inventories, basic weapons performance data, other system performance data, geographic and terrain data, and tactical decision data.

OUTPUT: Casualties and systems losses, FLOT traces and force positions over time, and availability and condition of forces and supplies. These outputs will be principally graphic in nature. Logistics and maintenance transaction files that can be input to a user-developed postprocessor.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780, SUN 4/280.
Storage:	40 MB RAM, 500 MB mass storage.
Peripherals:	CRT, high-speed printer, and high-resolution color printer.
Language:	SIMSCRIPT II.5.
Documentation:	None (model under development).

SECURITY CLASSIFICATION: Model is unclassified, but input and output are expected to be classified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: As needed.

Users: TRAC-LEE and U.S. Army Logistics Center.

Comments: Since the model is only in the planning stage, the above information comes from the preferred requirements and may change by the time the model is in production (it is estimated that model development will come off hold in 1992).

TITLE: LOCNES II - Lock-On Range Calculations Needed in Electro-Optical Simulation II.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis and Evaluation Branch Electronic Warfare Division.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: LOCNES II is a computer program which determines the infrared (IR) lock-on ranges of IR seekers targeted against aircraft and/or cruise missile with known IR signatures in the presence of a cloud background.

DESCRIPTION: The model can be used to determine either the IR lock-on range at different aspect angles relative to a target aircraft, or the IR lock-on ranges relative to a fixed Surface-to-Air Missile (SAM) site for different offsets ot the approaching target aircraft. Since IR lock-on range calculations are too time-consuming to be performed in engagement models which simulate many IR-homing missile/aircraft engagements, LOCNES II provides the parameters required for a simple scaling law to calculate IR lock-on ranges. The scaling law can be used to determine the IR lock-on for arbitrary values of visibility and surface water vapor density, the two observable, surface meteorological parameters whose variations are most directly related to variations in the IR lock-on range. This scaling law can be used in many-on-many engagement models which include variations in the visibility and absolute humidity at different locations. The program also determines the relative accuracy of the scaling law over a range of visibilities and surface water vapor densities. The IR lock-on range can be calculated with or without the effect of cloud radiation. The program utilizes the LOWTRAN 6 model for the atmospheric transmittance calculations which are required to solve the IR lock-on range equation.

The basic function of the LOCNES II program is to determine the IR lock-on ranges of specific IR seekers targeted against a penetrator (with a known IR signature) flying at a given altitude in a particular meteorological environment. This includes the effect of cloud radiation. The IR lock-on range is the maximum range between the IR seeker and the target aircraft for which lock-on can occur. The IR lock-on range will depend on the aspect angle between seeker and aircraft as well as the seeker and target characteristics.

A degraded lock-on range is calculated by determining the target range at which the irradiance of the target at the seeker is equal to that of a designated cloud. The approximate spectral attributes of the cloud are calculated for wavelengths greater than 1.8 um.

INPUT: LOCNES II will accept as input the target's spectral radiant intensity (kw/(sr-micron)) or the band-average radiant intensity (kw/sr) with any of the following options for wavelength intensity:

- A user-defined spectral distribution;
- A blackbody spectral distribution; or
- A spectral distribution which varies as the inverse square of the wavelength (used only for program verification).

Also, an approximate model for the target's aspect angle dependent IR signature may be selected as an option. For this case, the band average radiant intensity (kw/sr) and either the equivalent blackbody temperature or the normalized spectral distribution is input at nose-on, broadside, and tail-on aspect angles.

Meteorological condition options can be set by the user. One combination of the following atmospheric and haze models (the model atmosphere and haze data are contained in the LOWTRAN 6 program) must be selected:

Model Atmospheres	Haze Models
Tropical	Rural
Midlatitude Summer	Maritime
Midlatitude Winter	Urban
Subarctic Winter	Tropospheric
Subarctic Summer	Advection Fog
1962 U.S. Standard Atmosphere	Radiation Fog
User Defined	Radiation Fog
Any one of the first six models modified to be compatible with actual observations.	

In addition, the user specifies the sea level visual range (visibility) and may specify the temperature, pressure, and water vapor density at any specific altitude. The model atmosphere is then modified by multiplying the standard water vapor density selected by the user to the standard water vapor density given by the atmospheric model. The same procedure is applied to the pressure. The temperature, however, is scaled by adding a constant at all altitudes: the difference between the input temperature and the temperature given by the model atmosphere. This scaling procedure preserves the water vapor scale height contained in the particular model chosen and preserves hydrostatic equilibrium.

OUTPUT: The program output consists of a summary of the input data followed by either 1) IR lock-on ranges displayed at various elevation and azimuthal angles, or 2) IR lock-on ranges displayed at various offsets of a target aircraft relative to a fixed SAM site. In addition, quantitative validation of the scaling law for IR lock-on ranges may be provided in terms of the percentage difference between the IR lock-on ranges determined by the program and those determined by the scaling law.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780.
- Storage: 157,696 bytes.
- Language: FORTRAN 77.
- Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 145 seconds; Typical run time: 355 seconds.

Users:

AFCSA/SASB
ASD/ENSSS
ASDI
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Boeing Advanced Systems
Boeing Aerospace
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
Dalmo Victor Inc., The Singer Company
E-Systems, Greenville Division
ECAC
General Dynamics
General Dynamics/Convair Division
General Dynamics/Electronics Division
General Research Corporation
LTV Missiles and Electronics Group
Loral Advanced Projects
McDonnell Aircraft Company
Merit Technology Inc.
NASA Lewis Research Center
Naval Air Development Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Defense Systems Division
OptiMetrics, Inc.
Rockwell International/NAAO
SAIC
TRW/Military Electronics & Avionics Division
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
W J Schafer Associates
WL/AAWW-3
Westinghouse Electric Corporation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: LOEM - Launcher Orders Evaluation Model.

DATE IMPLEMENTED: 1985

MODEL TYPE: Analysis.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.J. Ondrish, (301) 231-2097.

PURPOSE: LOEM is used to evaluate the capabilities of conventional STANDARD Missile (SM) launchers for a naval AAW weapon system.

DESCRIPTION:
Domain: Air.

Span: Worldwide.

Environment: Naval, at sea.

Force Composition: One ship.

Scope of Conflict: Conventional.

Mission Area: AAW.

Level of Detail of Processes and Entities: This model evaluates all aspects of a launcher's capability. The target and search radar model assumes a point target moving in 3-dimensional space. The inputs to the target model define initial target position at time-zero. Target speed, course, and climb and dive angles are represented by tabular functions of time with linear interpolation between tabulated points. Thus any flight path can be represented. The simulated radar is reasonably assumed to scan the target. Scan time variations of real targets are usually small and are time-tagged and rate compensated within the radar. Measured range, bearing, and evaluation are represented in the simulation as true values corrupted by the addition of Gaussian distributed random errors. The model ends at first missile movement; it prepares for engagement but does not simulate the firing of the missile.

CONSTRUCTION:
Human Participation: Not required after setup.

Time Processing: Dynamic.

Treatment of Randomness: Deterministic, but the radar model includes stochastic processes for acquisition of target.

Sidedness: Two-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Initial target position and other basic parameters.

OUTPUT: Dynamic simulation printout.

HARDWARE AND SOFTWARE:
- Computer: IBM.
- Storage: N/A.
- Peripherals: Printer.
- Language: CSMP and FORTRAN.
- Documentation: Notes.

SECURITY CLASSIFICATION: N/A.

GENERAL DATA:

Data Base: Resident in model.

CPU time per Cycle: Less than one minute.

Data Output Analysis: Hardcopies available for analysis.

Frequency of Use: Occasionally.

Users: Vitro uses LOEM in support of NAVSEA (TARTAR Program).

Comments: This simulation model has been used in the past five years to evaluate improvements to the SM Weapon Direction System.

TITLE: LOGATAK III - Logistics System Attack III.

DATE IMPLEMENTED: July 1984.

MODEL TYPE: Analysis.

PROPONENT: Defense Nuclear Agency, Theater Forces Division, Kirtland Air Force Base, NM 87117-5000.

The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Edmund J. Bitinas (BDM), (703) 848-5246.

PURPOSE: LOGATAK III is a research and evaluation tool that can be used to support weapon systems effectiveness and force capability and requirements in order to assess courses of action, mix of systems, effectiveness, and resource planning and combat development for current or new doctrine and competing strategies in the broad areas of forces sustainability, mobilization and interdiction survivability, and effectiveness of ground forces and their supporting systems (airlift, sealift, ground transport, etc.).

DESCRIPTION:
Domain: A transportation network representing sea, air, or ground transportation links and nodes.

Span: Data-driven, from global to local (division).

Environment: Data-driven, includes time of day and trafficability.

Force Composition: Individual vehicles in convoy packages. Airlift sealift, and heliborne can also be included.

Scope of Conflict: Rear-area. Weapons represented by the effect of using them, including persistent effects such as radiation and chemical contamination.

Mission Area: Sustainability, mobilization, and interdiction.

Level of Detail of Processes and Entities: Vehicles as individuals grouped into convoys (up to 99 types of vehicles), items of supply specific or by tonnage (up to 9999 types), specific supply bases, and specific targets. Attrition/damage is input by weapon type, and delay is input as time to repair/reconstitute once assets to perform the repair are made available.

CONSTRUCTION:
Human Participation: Not required. Model interruptable with scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic. Random values are generated from input distributions.

Sidedness: One-sided.

LIMITATIONS: Consumption of supplies, attacks, and loss of territory must be pre-scripted.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional enhancements to railroad movement logic for peacetime background traffic.

INPUT: Transportation network (road and rail are available for all of Europe, Korea, and Iran, while only railroad data bases are available for the Soviet Union), scenario, asset stockpiles, asset consumption rates, logistics vehicle capabilities and force size, time of movement source and destination.

OUTPUT: Printed listing of resource and network utilization, supply availability, and force arrival rates. Postprocessor graphics for dynamic measures.

HARDWARE AND SOFTWARE:

Computer:	Any VAX/VMS or IBM PS/2 version available.
Storage:	1 MB.
Peripherals:	Printer and hard copy graphics.
Language:	FORTRAN with DISSPLA graphics.
Documentation:	User's manual and internal code documentation.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: One to three man-months.

CPU time per Cycle: Depends on scenario and scale; typically one to eight hours for entire run.

Data Output Analysis: Postprocessor provides graphics as well as raw data output.

Frequency of Use: One to three studies per year.

Users: U.S. Army Logistics Center and The BDM Corporation.

Comments: None.

TITLE: LOGNET - Logistics Data Network.

DATE IMPLEMENTED: July 1987 (Interim System).

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Logistics Evaluation Agency, Logistic Plans and Analysis Division (LOEA-PL), New Cumberland, PA 17070-5007.

POINT OF CONTACT: Mr. Michael G. Rybacki, (717) 770-6654, AV 977-6654.

PURPOSE: LOGNET is used primarily to assess materiel requirements and shortfalls of theater-level operation plans. It determines the EOH status of units in a force list and calculates an equipment redistribution plan to improve EOH status. LOGNET also calculates sustaining requirements and shortfalls for the force over time.

DESCRIPTION:

Domain: N/A.

Span: Theater-level aggregation for sustainment.

Environment: N/A.

Force Composition: Army units.

Scope of Conflict: Conventional warfare.

Mission Area: Materiel course-of-action assessment driven by major end item equipment densities.

Level of Detail of Processes and Entities: EOH status and redistribution are determined on a unit basis. Sustainment is computed in five-day increments beginning at d+000. Requirements and shortages are recorded by line item number and NSN for major end items, by standard study number and DoD Ammunition Code for ammunition, and by NSN for secondary items and bulk petroleum.

CONSTRUCTION:

Human Participation: Required for selection of parameters and processes.

Time Processing: Dynamic, time-step in five-day increments.

Treatment of Randomness: Deterministic using expected rates.

Sidedness: One-sided.

LIMITATIONS: Interim system is limited to assessment of major end items of equipment, conventional ammunition, bulk petroleum, and secondary items (identified as critical spare and repair parts in support of major end items on critical items lists).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Full operational capability, which will include all classes of supply, is planned as an integral function within the Army WWMCCS Information System.

INPUT: Time-Phased Force Deployment List, materiel replacement and consumption rates, and Total Army Equipment Distribution Plan.

OUTPUT: Printouts and screen displays of time-phased materiel requirements and shortages. Redistribution plan is available on magnetic tape.

HARDWARE AND SOFTWARE:

Computer: VAX computer with VMS operating system. Note that LOGNET functions in a dedicated machine environment.

Storage: N/A.

Peripherals: N/A.

Language: Pascal, COBOL, VAX-11 Macro ASSEMBLY, and Ada.

Documentation: In accordance with DoD Instruction 7935.1.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Three to seven days after receipt of data files.

CPU time per Cycle: Depends on size of force list and selection of critical items lists.

Data Output Analysis: Hardcopies of output reports. Limited capability for ad hoc query and tailored reports.

Frequency of Use: Varies by site.

Users: HQDA ODCSLOG, HQ FORSCOM, HQ USAMC, USALEA, and USAMC-LPSA (host site).

Comments: System operates on a dedicated secure computer network.

TITLE: LOWTRAN 7.

DATE IMPLEMENTED: February 1989.

MODEL TYPE: Analysis.

PROPONENT: Geophysics Laboratory, Atmospheric Effects Branch, Hanscom AFB, MA 01731-5000.

POINT OF CONTACT: Maj Greg J. Donovan, 697-5793.

Model available from National Climate Center, NOAA, Environmental Data Services, Federal Building, Asheville, NC 28801, (704) 259-0682, Ms. Yoland Goodge.

PURPOSE: LOWTRAN 7 calculates atmospheric transmittance and radiance, solar and lunar radiance, direct solar irradiance, and multiple scattered solar and thermal radiance averaged over 20 1/cm intervals.

DESCRIPTION:
Domain: Air.

Span: Global.

Environment: Profiles for 13 minor and trace atmospheric gases.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Individual band models for H20, 03, N20, CH4, CO, 02, C02, NO, N02, NH2, NH3, and S02.

CONSTRUCTION:
Human Participation: Required for some parameter inputs.

Time Processing: Static.

Treatment of Randomness: Deterministic based on user inputs.

Sidedness: One-sided.

LIMITATIONS: Not all atmospheric gases are considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Unknown.

INPUT: User choice of gas, path length, and wavelength.

OUTPUT: Computer printouts, plots, and raw data.

HARDWARE AND SOFTWARE:

Computer:	Available in several versions, compatible with most mainframe computers. ONTAR Corporation, 129 University Road, Brookline, MA 02146, produces PC version validated by Geophysics Lab for IBM PC/XT/AT, 80386, or compatible computer.
Storage:	N/A.
Peripherals:	N/A.
Language:	N/A.
Documentation:	N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: Unknown.

Data Output Analysis: N/A.

Frequency of Use: Sporadic; based on study demand.

Users: Numerous government agencies, research groups, and laboratories.

Comments: N/A.

TITLE: LPXMED - External Logistics Processor, Medical Module.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis (but can be used as an exercise driver).

PROPONENT: Studies, Concepts, and Analysis Division, J-4, The Joint Staff, The Pentagon, 2E827, Washington, DC 20318-4000.

POINT OF CONTACT: CDR J. Eller, Commercial (703) 695-9234.

PURPOSE: LPXMED is designed as a logistics course of action analysis tool. It is used to observe the performance of available medical logistics networks under varying conditions and compare alternate courses of action.

DESCRIPTION:
Domain: Theater medical logistics functions. Land, sea, and air evacuation assets. Medical facilities from any and all services can be represented.

Span: LPXMED can accommodate any scale, from one medical facility to a theater network.

Environment: LPXMED is independent of terrain and weather although it can simulate different terrain types and their restrictions on patient evacuation. The evacuation routes can surface and/or air routes.

Force Composition: Each module of LPX will represent those forces appropriate to its logistics function; i.e., LPXMED (the medical module) will portray the medical network in the given scenario. LPX is a one-sided model although either side can be played.

Scope of Conflict: LPXMED is flexible enough to represent conventional and/or NBC issues.

Mission Area: LPXMED is designed to simulate all medical procedures as defined by doctrine. This is to include patient treatment procedures, theater usages, multiple types of evacuation assets.

Level of Detail of Processes and Entities: The lowest entity modeled is a single patient, physician ambulance, or evacuation helicopter. The processes within LPXMED (triage, treatment, evacuation) affect a patient or group of patients.

CONSTRUCTION:
Human Participation: Is not required but the model is interruptable for reviewing and possible change of the data set.

Time Processing: LPXMED is a dynamic, time-stepped model. The time-step is variable through user input.

Treatment of Randomness: In LPXMED, patient casualty severity, initial entry time of the patient in the medical network, are some of the factors that are determined stochastically by a Monte Carlo determination.

Sidedness: One-sided model.

LIMITATIONS: The length of an LPXMED run is limited by the available computer memory.

INPUT: LPXMED takes an input TPFDD data (such as unit type, unit arrival times), medical unit characteristics, casualty treatment data from the DEPMEDS data base, evacuation asset characteristics, medical network information.

OUTPUT: Produces printouts of network bottlenecks, facility, evacuation asset, treater type, and supply type usages by time and echelon. Postprocessor provides graphical view of above raw data.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on an IBM PC (or compatible) under the DOS operating system.
Storage:	Minimum of 3 Megabytes of hard-disk space (scenario dependent). Works best with a minimum of 2 Megabytes of extended memory.
Peripherals:	Requires an EGA or VGA monitor. To print out the reports of graphs from the postprocessor, a dot-matrix (EPSON compatible) printer is required.
Language:	LPXMED is written entirely in "C" language.
Documentation:	Extensive in-code documentation in addition to a user's guide and system's manual. Also provided is a tutorial that leads a new user through three situations and provides a detailed description of possible steps (on-screen data modification) to solve them.

SECURITY CLASSIFICATION: LPX is an unclassified model.

GENERAL DATA:

Data Base: All modular components of required data exist in the default data base. To modify this data to suit a particular scenario would take one week.

CPU time per Cycle: Dependent on scenario size and hardware configuration. A small scenario (tutorial) takes 10 seconds of CPU time per 24 hours of simulation time.

Data Output Analysis Postprocessor produces hardcopies and charts of raw data to assist the medical planner in analysis.

Frequency of Use: LPXMED (version 1.0) was fielded on 1 May 1991. Currently briefing and training potential users. Anticipate usage to be scenario dependent.

Users: Potential users are logistics planners both at the CINC and the service levels.

Comments: LPXMED is currently being linked to TACWAR. The casualties resulting from this combat model (or any other) will be used to derive the casualties that are inputs to the medical model. A postprocessor to LPXMED will allow the model to scan a TPFDD extract and automatically build the medical network of the given scenario.

TITLE: LRSAMP - Long Range Strategic Appraisal and Military Planning System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Strategic Plans and Policy Directorate (J-5), The Joint Staff, The Pentagon, Rm 2E949, Washington, DC 20318-8000.

POINT OF CONTACT: Dr. Jeffery Milstein, (703) 695-0025.

PURPOSE: LRSAMP is used primarily to analyze, forecast, plan, and provide decision support capabilities for satisfying long-range (out to 20 years) goals. These analyses help produce JSPS documents and aid the strategic planner in choosing appropriate strategies to meet U.S. national strategic goals.

DESCRIPTION:

Domain: Strategic assessments and military planning.

Span: Global and regional.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Plans and policy.

Level of Detail of Processes and Entities: Countries and regions.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step and event-step. Progresses through events at a user-specified ration of exercise time.

Treatment of Randomness: Deterministically based on planning concepts and rules.

Sidedness: N/A.

LIMITATIONS: Bounded domain of proposed strategic plans and programs.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Prototype under development.

INPUT: A user-created event (question), one strategic goal, and one region of the world.

OUTPUT: Graphics-based output charts and diagrams of military strategies and impacts of military strategies on specific goals.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a SUN microcomputer with UNIX operating system.
Storage:	N/A.
Peripherals:	One printer and one color monitor.
Language:	"C" and FORTRAN.
Documentation:	Preliminary user requirements, system data flow diagrams, system analytical tools report.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:
Data Base: Large historical data bases as well as current data CPU times per cycle.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: J-5 Strategy Division.

Comments: LRSAMP will be built on existing components of the Future Options Research Execution for the Computer Analysis of Scenario Tracing and Simulation (FORECASTS) system. This task is establishing a plan for the development of an LRSAMP system by determining system requirements through prototyping. The prototype system is being developed through the use of an expert system shell, NEXPERT Object. Additional statistical and decision analysis tools are being investigated to meet J-5 Strategy Division requirements.

TITLE: LTM - Laser Threat Model.

DATE IMPLEMENTED: July 1987.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: LTM is used to assess the damaging effects of high or low powered laser weapons against a dynamic airborne target.

DESCRIPTION:

Domain: Air and land.

Span: Individual.

Environment: Terrain relief.

Force Composition: Element.

Scope of Conflict: Conventional, directed energy weapon.

Mission Area: N/A.

Level of Detail of Processes and Entities: LTM simulates both low and high power laser weapons, laser propagation and attenuation effects, probabilistic terrain, and a variety of visibility conditions (day, night, fog, and temperature). LTM considers radar clutter, ground and airborne target signatures (infrared, visual, radar), terrain and sky background, and sensor damage.

CONSTRUCTION:

Human Participation: Not required.

Time Processing:

Treatment of Randomness: Stochastic, Monte Carlo and deterministic modes.

Sidedness: One-sided.

LIMITATIONS: LTM does not simulate battlefield obscurity due to dust or smoke and it does not simulate terrain masking.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: LTM requires sensor, fire control, pointing, tracking, and firing data for the laser weapon system and environmental data on atmospheric visibility and terrain.

OUTPUT: LTM generates friendly aircraft success/failure and survival/death probabilities and a report of laser effects for each system, subsystem, component, accumulation point, and failure mechanism. Detailed output includes a runstream of all major variables and all random seeds used.

HARDWARE AND SOFTWARE:

Computer: VAX with VMS.

Storage: 2.3 MB.

Peripherals:

Language: FORTRAN 77.

Documentation: LTM Data Base Specification, LTM Functional Description Manual, LTM Installation Guide, LTM Programmer's Manual, and LTM User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: LWLCCM - LWLC/ASPJ Campaign Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill High, ITT Avionics Division, (201) 284-2870.

PURPOSE: Deterministic one-on-many of A/C penetrator vs. ground based SAM weapon systems.

DESCRIPTION: Model computes cumulative survivability as function of penetrator sortie parameters (including ECM) and threat laydown and characteristics.

INPUT: Penetrator: RCS, flight path, ECM type and parameters SAMs: radar (track) parameters, weapon kill parameters.

OUTPUT: Penetrator survivability.

HARDWARE AND SOFTWARE:
- Computer: SEL; Source program on mag tape.
- Storage: 5K Bytes; memory requirements: minimal.
- Language: FORTRAN 4 (SEL).
- Documentation: Technical Memoranda.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is Secret.

GENERAL DATA:

Data Base: Typical data preparation is 5 minutes.

CPU time per Cycle: 5 minutes on SEL computer.

Comments: Status of Model - completed, debugged; full verification and validation done.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: MABS-EX - Mixed Air Battle Simulator - Extended.

DATE IMPLEMENTED: Unknown.

MODEL TYPE: Analysis.

PROPONENT: USCINCPAC Staff (J55), Box 15, Camp P.M. Smith, HI 96961-5025.

POINT OF CONTACT: Mr. Ronald H. Uyehara, (808) 477-6467, AV (315) 477-6467.

PURPOSE: MABS-EX examines the effectiveness of an integrated air defense to evaluate force capabilities and develop force requirements. MABS-EX is used to study factors that influence the effectiveness of air defense systems. The model permits varying the numbers, locations, and characteristics of radars SAM sites, AA guns, short-range SAMs, interceptors, bombers, ordnance, and noise-jamming equipment. The effectiveness of an air defense system is judged based on its ability to inflict damage on the enemy and prevent damage to itself.

DESCRIPTION:
Domain: Air. MABS-EX models the airspace needed to simulate an air attack on an air defense system. The geographical area that can be treated is limited only by the extent to which the earth's surface can be approximated by a rectangular coordinate system.

Span: Local and regional. Larger simulations are limited by the number of entities that can be represented. Position errors caused by projecting entities from a spherical surface onto a planar surface also limit MABS-EX applications above the regional level.

Environment: A smooth earth's surface is assumed with limited capabilities to model radar masking. Angle-to-mask, range-to-mask, and masking sector are the only radar masking parameters.

Force Composition: Large air attacks directed against an air defense network.

Scope of Conflict: Conventional.

Mission Area: Air defense.

Level of Detail of Processes and Entities: Individual aircraft or multiple-aircraft tracks. Individual radars and SAM sites. Attrition is bilateral.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric (one side nonreactive).

LIMITATIONS: Numbers and types of aircraft and SAM sites are limited; ECM is not modeled; flat earth is assumed for navigation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None currently

INPUT: Numbers of radars, SAM sites, interceptors, bombers, and tankers of each type; effective ranges and pKs for weapons such as SAMs, AA guns, and air-to-air missiles; radar ranges or a listing of "detect/leave" events generated outside the model (see description of MPRES model); terrain masking (range to and height of nearest obstacle); speeds and ranges of bombers; speeds and fuel consumption rates of interceptors; bomb damage potential (number of bombs, type of target, and expected CEP); IFF characteristics (probability of correct identification and probability of misidentification); and fire control delays and failure factors.

OUTPUT: Damage to each type of aircraft (number killed or damaged by each ground-to-air and air-to-air weapon system); damage to ground targets (fraction of each ground target surviving); summary of damage by each SAM system type; numbers and types of bombers surviving and used in each computer-generated attack wave; numbers of interceptors on the ground, assigned, in maintenance, attacking, and returning to base versus time for all attack waves.

HARDWARE AND SOFTWARE:

Computer:	Wang VS80B (OS 6.4); currently being rehosted to SUN 3/260 system.
Storage:	10 MB.
Peripherals:	Interactive terminal, printer.
Language:	FORTRAN IV.
Documentation:	User Manual available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 2 to 3 man-months.

CPU time per Cycle: 2 to 60 minutes.

Data Output Analysis: Variable.

Frequency of Use: As needed.

Users: USCINCPAC; U.S. Forces Japan; Combined Forces Command, Korea; Japan Self Defense Forces.

Comments: An attempt to rehost this model to the VAX 8650 was unsuccessful because the bit-packing scheme of the MABS-2X is incompatible with the VAX representation of integers. See the Planned Modifications section above.

TITLE: MACATAK - Maintenance Capabilities Attack Model.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Bruce Lasswell, (804) 734-1050/3449, AV 687-1050/3449.

PURPOSE: MACATAK is an operations support tool that measures the survivability and vulnerability of division-level maintenance elements in conventional, chemical, and nuclear environments. The model assesses the effectiveness of the maintenance system as it experiences attacks both on end items it supports and on the system itself.

DESCRIPTION:

Domain: Land.

Span: Variable.

Environment: N/A.

Force Composition: Primarily division-level maintenance elements.

Scope of Conflict: Conventional, chemical, and nuclear.

Mission Area: Maintenance system.

Level of Detail of Processes and Entities: The maintenance system and the end items it supports can suffer attrition. End item types come into the system due to combat damage and RAM. End items wait in queues for parts, skills, and equipment, and the waiting time is used in the computation of maintenance turnaround time (TAT). Maintenance TAT is assessed for each end item type as a function of waiting time and repair time.

CONSTRUCTION:

Human Participation: Not required--scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Number and type of equipment in each using unit; number and MOS of maintenance personnel; inventory of DX components at each maintenance activity; equipment usage rates and failure rates; maintenance action information such as time to repair, frequency of occurrence, and contact team; time it takes for parts to arrive; and scenario.

OUTPUT: Tabular printouts of probable equipment availability; tabular listing of equipment maintenance TAT; tabular listing of TAT broken into function segments; and tabular printouts of queue sizes for parts, skills, and equipment as a function of time. A binary transaction file is created for additional postprocessing.

HARDWARE AND SOFTWARE:

Computer: VAX 11/780.
Storage: Variable.
Peripherals: Printer and tape drive.
Language: FORTRAN IV, GASP IV, and FORTRAN 77.
Documentation: Maintenance SupPort Study for INFS, March 1980; Users' Manual for MACATAK, March 1980; and Programmers' Guide for MACATAK, March 1880.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Varies.

Data Output Analysis: One to four weeks.

Frequency of Use: As needed.

Users: Proponent, U.S. Army Ordnance Missile and Munitions School, U.S. Army Logistics Center, and BDM Corporation.

Comments: MACATAK was created using the Models of the Army Worldwide Logistics System (MAWLOGS).

TITLE: MACRO.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Vector Research, Incorporated, PO Box 1506, Ann Arbor, MI 48106.

POINT OF CONTACT: George Miller, (313) 973-9210.

PURPOSE: MACRO is a research and evaluation tool dealing with force capability and requirements. It is useful for providing a setting for corps-level studies, performing large-scale force structure analyses, filtering alternative strategies prior to a detailed study, and making quick tradeoff estimates.

DESCRIPTION:

Domain: Land and air.

Span: Theater.

Environment: MACRO represents the diurnal cycle, position preparation, and maximum force size; the user may influence force density and maneuverability limitations.

Force Composition: Joint and combined forces; Blue and Red.

Scope of Conflict: Conventional warfare.

Mission Area: AirLand Operations, including air war.

Level of Detail of Processes and Entities: MACRO is a highly aggregated model whose corps-level structure and results are based on fits to the results of more detailed corps-level models. Forces are divided into fixed wing aircraft, attack helicopters, artillery (with associated ammunition classes and limits), short range anti-tank weapons, and ground maneuver forces; representation of these forces requires the user to translate details of military forces and operations into the abstract form required by the mathematical models embedded in the simulation. Forces are affected by eight processes: arrival, commitment to corps areas from theater rear, intersector transfer, movement within corps areas, attrition, retirement from corps areas, reconstitution, and repair.

CONSTRUCTION:

Human Participation: Not required; scheduled changes are allowed.

Time Processing: MACRO is a dynamic model that consists of a set of linked differential equations describing the trajectory of campaign results over time; the equations are solved by Runge-Kutta techniques.

Treatment of Randomness: Deterministic--employs differential equations to approximate expected campaign results over time.

Sidedness: Two-sided and almost symmetric (Blue can conduct nonlinear operations; Red cannot).

LIMITATIONS: Because MACRO is fitted to the results of more detailed models, it requires review of fitted parameters and sometimes model equations in the light of the forces, weapons, and tactics to be studied. In addition to refitting parameters to more recent corps-level results, methods of updating some fitted coefficients (based on age of technology considerations) have been developed in order to represent new weapons or tactics.

PLANNED IMPROVEMENTS AND MODIFICATIONS: MACRO fits are periodically updated as new detailed model results become available. Other enhancements are made as needed to support specific study requirements.

INPUT: 1) initial values of the state vector; 2) theater-level data, much of which is used by the algorithms governing commitment of forces; 3) corps-level performance and tactical data, including data describing the fit to more detailed campaign models; and 4) data describing force arrivals.

OUTPUT: 1) a periodic situation display in each corps, describing allocations, strengths, and attrition of forces by type; force transfers by type; FLOT positions, separation, and movement rates; total force in theater reserve, reconstitution, and repair; and selected effectiveness measures; 2) a periodic display of the state vector in each corps; 3) a periodic summary of air war allocations, kills, losses, and selected effectiveness measures; 4) a periodic summary of replacement pools and repair queues in each corps; 5) a periodic summary of intersector transfers of forces and ammunition; and 6) a cumulative trace of kill attributions by corps sector. Output frequency is controlled by the user.

HARDWARE AND SOFTWARE:

Computer:	MACRO runs on CDC, IBM, and Amdahl mainframe computers, Concurrent and DEC minicomputers, SUN workstations, and IBM-PC micro-computers under a variety of operating systems.
Storage:	Between 420,000 bytes and 1,500,000 bytes, depending on the size of the region being played and the computer used.
Peripherals:	No special peripherals are required.
Language:	Transportable FORTRAN.
Documentation:	User's Manual, unpublished user's technical notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One- or two-person days for application of the model with an existing fit; significantly more time to refit to new detailed model results.

CPU time per Cycle: Between five minutes and 30 minutes for a 30-day war, depending on the number of corps sectors played and the computer used.

Data Output Analysis: A few minutes to a few hours are required to analyze the output for a 30-day war.

Frequency of Use: Several studies per year.

Users: SHAPE Technical Center (STC); Defence Operational Analysis Establishment; IABG, Trier; Vector Research, Incorporated.

Comments: Original fit was based on results of STC's Armour/Anti-Armour Study of the NATO Central Region using the highly detailed VECTOR-2 campaign model. Subsequent updates to fitted parameters have been based on a variety of studies or specific refitting efforts using results from the ALB-XMOD and VECTOR-3 models.

TITLE: MACRO 2 - Model of Aggregated Central Regional Operations.

DATE IMPLEMENTED: 1987.

PROPONENT: SHAPE Technical Centre, PO Box 174, 2501 CD The Hague, The Netherlands.

POINT OF CONTACT: T. Langsaeter, Commercial 070-3142303, IVSN 257-2303.

PURPOSE: MACRO-2 is used in the context of dynamic analysis of arms control options for preliminary quick assessments of force capabilities under different assumptions of force reductions.

DESCRIPTION: MACRO-2 is a two-sided aggregate, representation of conventional land combat in the NATO Central Region (also a Southern Region version has recently been developed). Structurally, the model is a set of difference equations describing changes in force strengths in various corps areas, FEBA positions and velocities, cumulative commitments, losses, etc. The forces in MACRO-2 are divided into OAS-aircraft, helicopters, artillery and ground forces not otherwise broken out. Forces may be at two distinct depths within a corps area, or may be behind the corps areas. Forces are affected by six processes including arrival, commitment to corps area, attrition, retirement from corps areas, reconstruction of retired forces and repair of kills. Deployment of forces from regions and allocation of air support is automated according to a 'preselected concentration points' versus 'cohesive defence' philosophy.

CONSTRUCTION:

Human Participation: Not permitted (close loop simulation).

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: MACRO-2 has to be calibrated to the results from more detailed models (IDAHEX wargame results), hence new calibration is necessary when different force structures and different tactics are introduced. Representation of air-ground combat is rudimentary, and the air-air combat is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Scenario data like: in place forces, reinforcements, availability times, main axes of attacks, etc., and corps level performance data like attrition coefficients, terrain and defence preparation, characterization, reconstitution times, etc.

OUTPUT: Computer printout with a tabular summary of the situation printed at user selected intervals (typically once a day).

HARDWARE AND SOFTWARE:

Computer:	CYBER 840 under NOS VE IBM PC AT, IBM P52 or equivalent under MS-DOS.
Storage:	250K for the PC version.
Peripherals:	Printer (preferably with 14' paper).
Language:	FORTRAN V.
Documentation:	Under preparation.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Calibration can take one to two months, and rest of data base less than a week.

CPU time per Cycle: Less than 15 seconds on P52 (6 hour cycles).

Data Output Analysis: One day or less.

Frequency of Use: Variable.

Users: SHAPE Technical Centre; Defence Operational Analysis Establishment; Industrieanlagen-Betriebsgesellshaft mbH Trier.

TITLE: MADMM - Minefield Attrition and Delay Mobility Model.

DATE IMPLEMENTED: April 1991.

MODEL TYPE: Analysis.

PROPONENT: Commander and Director, U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-GM-L, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

POINT OF CONTACT: Dr. John V. Farr, 601-634-4144.

PURPOSE: The MADMM is a research and evaluation tool to support weapons system analysis and development for combat engineering equipment, analyzing the synergistic effects of covering fire and minefields, and breaching tactics.

DESCRIPTION:

Domain: Battalion size engagement area.

Span: Individual.

Environment: Limited terrain representation.

Force Composition: Combined armor and engineer vehicles.

Scope of Conflict: Conventional weapons.

Mission Area: Mobility, countermobility, and survivability missions.

Level of Detail of Processes and Entities: The model represents individual vehicle response.

CONSTRUCTION:

Human Participation: Not required for model operation.

Time Processing: Dynamic, time- and event-stepped.

Treatment of Randomness: Uses stochastic techniques for probability of detection, probability of kill, mine encounters, and indirect fire with Monte Carlo determination of results.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: Limited to battalion size with four companies. Very general representation of terrain.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Model has a graphics preprocessor to aid in input development. Data needed includes ph and pk for various mines against vehicles and breaching equipment.

OUTPUT: Output is in tabular form.

HARDWARE AND SOFTWARE:

Computer:	IBM PC or compatible. Best if run on an 80836 machine.
Storage:	Executable, source code, and data files are approximately 0.5 megabytes.
Peripherals:	Minimum requirements: EGA monitor and a mouse.
Language:	C and FORTRAN.
Documentation:	User's guide and methodology is contained in a WES Report.

SECURITY CLASSIFICATION:

GENERAL DATA:

Data Base: Mainly vehicle and mine properties.

CPU time per Cycle: Depending upon computer and scenario, typically one minute of CPU time per repetition.

Data Output Analysis: Output results are written to ASCII files for further analysis.

Frequency of Use: Presently in final stages of development and thus has not been distributed.

Users: WES, U.S. Army Engineer School, and others interested in mine warfare effects.

TITLE: MAM - Maritime Analysis Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis, training, and education.

PROPONENT: Force Structure, Resource and Assessment Directorate (J-8), Joint Staff, Politico-Military Assessment Division (PMAD), The Pentagon, Room 1D929, Washington, DC 20318-8000.

POINT OF CONTACT: CDR Craig Perry, AV 225-2020, Commercial (202) 695-2020.

PURPOSE: Training and education; seminar exercise driver.

DESCRIPTION:
Domain: Air, sea.

Span: The Maritime Analysis Model (MAM) is designed to simulate global and regional naval movement, detection and combat.

Environment: MAM can be used with or without any type of map and counters to echo the model's automated movement and positioning of forces.

Force Composition: Combined, Joint, Air/Naval. Units represent individual platforms.

Scope of Conflict: Conventional warfare.

Mission Area: Sea control, surveillance, loading/unloading of cargo, transiting.

Level of Detail of Processes and Entities: One or more individual units (ships, aircraft, or subs) are placed in groups for movement, detection, and combat actions. The detection and stealth values of the group's units are aggregated and used in conjunction with the speed of the group to determine, through a random search process with the exact locations of groups within an area unknown, the probability of detection of enemy groups. Given a successful detection, a group will engage another in combat. Combat is adjudicated by each platform in the attacking group firing its appropriate weapons at units in the defending group. Units in the defending group are capable of defeating incoming missiles, and are then capable of launching a counter attack.

CONSTRUCTION:
Human Participation: Not required, although recommended before and or during each game turn.

Time Processing: Dynamic, time-stepped.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided.

LIMITATIONS: Random search process assumes no search plan, and no definitive location of groups within an area. Detections cannot occur across area boundaries.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Investigating the use of a rule-based, manual procedure for campaign actions, while adding more detail and accuracy to the engagement portion.

HARDWARE AND SOFTWARE:

Computer(OS):	IBM PC 286, 386 or compatible; MS-DOS.
Storage:	1.6Mb RAM is the minimum memory configuration; (640Kb base, 1 Mb extended).
Peripherals:	1 printer, will run faster with math co-processor, but not required.
Language:	ADA.
Documentation:	None.

SECURITY CLASSIFICATION: Unclassified model; data bases may be classified.

GENERAL DATA:

Data Base: Most data bases can be built in a day.

CPU time per Cycle: Depends on the speed of the machine, and the number of engagements to be processed; normally from one to five minutes.

Data Output Analysis: Output is generated in a status report format for each group. An account of each weapon launching in each engagement is also listed. Option also available to produce a detailed "debug" version of output report.

Frequency of Use: Used occasionally by various groups listed below.

Users: J-8, SHAPE Technical Center, Joint Warfare Center, National Defense University, Canadian Forces Staff College, SACLANT, USLANTCOM.

Comments: The model is young, and considered to be in a prototype stage. Continually updated based on requirements of J-8/PMAD.

TITLE: MAPS - Mapping Analysis Propagation System.

MODEL TYPE: Analysis, Training Tool.

PROPONENT: USA CECOM Center for Signals Warfare, AMSEL-RD-SW-TRF, Vint Hill Farms Station, Warrenton, VA 22186-5100.

POINT OF CONTACT: Michael F. Davis, AV 229-7329, Commercial (703) 349-7329.

PURPOSE: MAPS is primarily used to analyze and graphically display the performance of IEW equipment and sensor placement of Army systems.

DESCRIPTION: MAPS is a static model that enables the user to model the propagation performance of any IEW system (RED/BLUE). The parametrics of the IEW system is supplied by the user; i.e., antenna height, power, frequency, etc., and placed by lat/lon on a map or area of concern.

Span: Accommodates any theater depending on the data base information; data base of IEW equipment is in preparation stage.

Environment: Models IEW equipment with respect with DTED (Digital Terrain Elevation Data) and environment conditions; i.e., sun flux, permitivity, humidity, and weather.

Force Composition: Blue and Red IEW equipment. (Ground and Airborne).

Mission Area: Conventional Intelligence Electronic Warfare.

Level of Detail of Processes and Entities: IEW equipment when modeled shows a variety of graphic displays with map overlays and the performance of one or many IEW assets. Some examples of the type of detailed displays are terrain overlays, Circular Error of Probability, Time Difference of Arrival, Differential Doppler, Line of Sight, and Propagation performance of the IEW systems in HF, VHF, environments.

CONSTRUCTION:
Human Participation: Presently the parametrics of the IEW equipment are typed into a forms based database. Future enhancements are to let the user pick the NIA (Named Areas of Interest) and TIA (Target Areas of Interest) and the placement of the IEW assets will automatically be placed in the tactical positions based on slope, weather, echelon priorities, and elevation.

LIMITATIONS: MAPS is limited to the availability of DTED from DMA. If DTED is not available, then a smooth earth algorithm is used.

INPUT: IEW sensor characteristics.

OUTPUT: Screen Display, color hardcopies and viewgraphs.

HARDWARE AND SOFTWARE:

Computer:	DEC Vaxstation 31XX (VMS), SPARCstation 2, (UNIX), and Hewlett Packard 9000/730, (UX).
Storage:	200 megabytes of disk and 5 megs of memory minimal.
Language:	C and Fortran.
Peripherals:	Optional Printer Output.
Documentation:	None.

SECURITY CLASSIFICATION: Unclassified without data.

GENERAL DATA:

Data Base: Preparation time is dependent on the number of entities needed to model the scenario. For example, one-on-one IEW asset will take approximately 5 minutes set up time.

CPU time per Cycle: VAXstation, 3.5 minutes, SPARCstation 45 seconds, Hewlett Packard 15 seconds for one-on-one.

TITLE: MARGI-SIOP - Strategic Air Command Methodology for Analyzing Reliability and Maintainability Goals and Investments.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: HQ AF/LE-RD, The Pentagon, Room 4E259, Washington, DC 20330-5130.

POINT OF CONTACT: Lt. Col. P. Aitken-Cade, HQ AF/LE-RD, (202) 697-2875, AV 227-2875; or Jim Kerr, ANSER Inc., (703) 685-3174.

PURPOSE: MARGI-SIOP is an evaluation tool that addresses the contribution of reliability and maintainability to the warfighting capability of nuclear bombers (e.g., B-1, B-52). It also serves as a valuable decision support system for prioritizing Class IV modifications.

DESCRIPTION:

Domain: Aircraft generation and in-flight to target.

Span: Global.

Environment: Enemy targets and enemy threat.

Force Composition: U.S. strategic forces.

Scope of Conflict: U.S. strategic nuclear.

Mission Area: Aircraft strategic nuclear missions.

Level of Detail of Processes and Entities: Aircraft subsystem level.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Event-step simulation for aircraft generation and sequential for in-flight calculation.

Treatment of Randomness: Stochastic, Monte Carlo for ground generation and deterministic expected value for in-flight calculation.

Sidedness: One-sided.

LIMITATIONS: One target only; recovery of aircraft not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Extend to encompass Class V modifications.

INPUT: Aircraft subsystem reliability, repair time, and spares availability, and the number of work crews capable of repairing the subsystems. In-flight success probability by mission flight phases for subsystem failure states.

OUTPUT: Tabulation of damage expectancy degrade due to each subsystem. Graphs also generated for sensitivity analysis on subsystem reliability.

HARDWARE AND SOFTWARE:

Computer:	IBM PC compatible with 512K RAM and MS DOS operating system.
Storage:	Two double-sided, double-density disk drives; removable hard drive preferred.
Peripherals:	Color graphics adapter and color monitor. Useful but not required to have Epson FX graphics capable printer.

Language: Turbo Prolog 1.1, Turbo Pascal 3.0, and Microsoft FORTRAN 77, Version 4.01.
Documentation: User's guide.

SECURITY CLASSIFICATION: Unclassified, but working data base is classified secret.

GENERAL DATA:
Data Base: One week.

CPU time per Cycle: Minutes.

Data Output Analysis: Immediate.

Frequency of Use: Several times per year.

Users: HQ SAC/XRRM, HQ SAC/XRTL, and various others.

Comments: Provisions for an integrated cost module to determine the life-cycle cost of a modification. Cost module available from Synergy Corporation.

TITLE: MARGI-TAC - Methodology for Analyzing Reliability and Maintainability Goals and Investments for Tactical Air Forces.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: HQ AF/LE-RD, The Pentagon, Room 4E259, Washington, DC 20330-5130.

POINT OF CONTACT: Lt. Col. P. Aitken-Cade, HQ AF/LE-RD, (703) 697-2875, AV 227-2875, or Jim Kerr, ANSER Inc., (703) 685-3174.

PURPOSE: MARGI-TAC is an evaluation tool that addresses the contribution of reliability and maintainability to warfighting capability. It also serves as a valuable decision support system for prioritizing Class IV modifications.

DESCRIPTION:

Domain: Land and air.

Span: Single base in theater.

Environment: Enemy targets, enemy threat.

Force Composition: U.S. tactical forces.

Scope of Conflict: U.S. tactical conventional.

Mission Area: Aircraft tactical air-to-ground missions.

Level of Detail of Processes and Entities: Aircraft subsystem level.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-step simulation.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: One target per sortie.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Extend to encompass Class V modifications.

INPUT: Aircraft subsystem reliability, repair time, and number of spares, and the number of work crews capable of repairing the subsystems. In-flight success probability by mission flight phases for subsystem failure states. Includes Analytic Hierarchy-based model to determine probabilities.

OUTPUT: Produces screens or printouts of number of targets destroyed, sorties, attrition, battle damage, etc. Shows relations of measures of effectiveness to subsystem reliability and maintainability. Graphs also generated for sensitivity analysis on subsystem reliability.

HARDWARE AND SOFTWARE:

Computer:	IBM AT or 386 compatible with 512K RAM and MS DOS.
Storage:	Two double-sided, double-density disk drives. Removable hard disk drive desired.
Peripherals:	Useful but not required to have color graphics adapter, color monitor, and Epson FX graphics capable printer.

Language: Turbo Prolog 1.1, Turbo Pascal 4.0, and Microsoft FORTRAN 77, Version 4.01.
Documentation: User's guide and annotated software.

SECURITY CLASSIFICATION: Unclassified, but working data base is classified secret.

GENERAL DATA:
Data Base: Initial data base one to four weeks.

CPU time per Cycle: Hours.

Data Output Analysis: Immediate.

Frequency of Use: Several times per year.

Users: HQ TAC/SMO R&M and various others.

Comments: Provisions for integrated war reserve spares kit and life cycle cost modules; available separately from Synergy Corp.

TITLE: Markov Survivability Model.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: CECOM AMSEL-PL-SA, Fort Monmouth, NJ 07703-5000.

POINT OF CONTACT: Mr. Edwin Goldberg, (201) 532-3646, AV 992-3646.

PURPOSE: The Markov Survivability Model is a research and evaluation tool that deals with combat development. It can assess the effects of design, operational, maintainability, and repairability options on the survivability of a system in a battlefield environment.

DESCRIPTION:
Domain: A combination of any of the above.

Span: Local.

Environment: Models the survivability of any system in a battlefield environment.

Force Composition: Component and element.

Scope of Conflict: Conventional.

Mission Area: Air, land, and sea weapons and systems.

Level of Detail of Processes and Entities: Systems component.

CONSTRUCTION:
Human Participation: Required for bounding the model and determining transition probabilities.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: One-sided.

LIMITATIONS: Depends on computational determination of transition probabilities. Analyzes one weapon system at a time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Transition probabilities; determined by experiment or analysis.

OUTPUT: Statistically analyzed data.

HARDWARE AND SOFTWARE:

Computer:	Any.
Storage:	Minimum storage required.
Peripherals:	Printer.
Language:	Any.
Documentation:	Proceedings, 26th Annual U.S. Army Operations Research Symposium, AORS XXVI, 13-15 October 1987, Fort Lee, VA, Volume III, pp. 35-49.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Time needed to prepare data base depends on the situation; typical time might be 30 days.

CPU time per Cycle: Negligible.

Data Output Analysis: Computer output is self-instructive and complete.

Frequency of Use: N/A.

Users: CECOM, Fort Monmouth and DoD consultants.

Comments: N/A.

TITLE: MARS - Multi-Warfare Assessment and Research System Model.

DATE IMPLEMENTED: IOC January 1992.

MODEL TYPE: Two modes: Engagement model mode and Man-in-the-Loop wargaming mode.

PROPONENT: Naval Surface Warfare Center, White Oak Laboratory, Code D25, 10901 New Hampshire Ave., Silver Spring, MD 20903-5000.

POINT OF CONTACT: Henry C. Ng, (301) 394-3732, AV 290-3732.

PURPOSE: The purpose of the MARS simulation system is to provide a user-friendly, battle-force level, Monte Carlo model of naval multi-warfare battle engagements of Anti-Air Warfare (AAW), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Strike Warfare (STW), Mine Warfare (MIW), and Electronic Warfare (EW). The simulation is used to evaluate the effects of new or existing platforms, weapons, or system capabilities, as well as command and control concepts, in the context of multiple platform engagement level analysis. The model is capable of simulating naval engagement situations ranging from battle force level to low intensity conflict. This includes CVBF (sea control, power projection and land strike attack of enemy territory), Surface Action Group (SAG), Underway Replenishment Group (URG), and Convoy and Amphibious Landing operations. The simulation uses generic algorithms to model or calculate system performance based on user defined characteristics and will provide similar fidelity to both offensive and defensive forces, allowing analysis of forces employed in either role. To achieve this goal, MARS provides a user-friendly Graphical User Interface (GUI), allowing for ease of setup, ease of data base and scenario design, and allows the reduction of learning time to use the model.

DESCRIPTION:

Domain: Land, sea, air, space, and undersea.

Span: Scalable - theater, regional, local, or individual.

Environment: All weather, all seasons (limited data bases).

Force Composition: Mix forces - combine, joint.

Scope of Conflict: Primarily conventional warfare.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: The simulation is an event-driven naval warfare simulation in a multi-warfare, multi-mission environment. The MARS simulation provides the battle simulation functions in either a non-interactive mode or a man-in-the-loop (wargaming) mode. In the non-interactive mode, the simulation provides a single or multiple iteration capability as well as a graphical display during simulation. In this mode, MARS provides a Monte Carlo simulation using a user input decision tree. This mode will generate statistics as output for conducting studies. In the man-in-the-loop wargaming mode, human decisions are employed to try different tactics, as well as to develop operational strategy. In both modes, the simulation functions includes platform kinematics, sensor detections, single and multiple platform data fusion, targeting, weapons assignment, resource allocation, cooperative engagement, launching of platforms, weapons and decoys, engagement outcome and battle damage assessment, and command and control, and communications. The simulation functions also include an interactive graphics display of the battle and selected measures of effectiveness. MARS uses Object-Oriented Analysis and Design (OOA&D) methodology for model structure and uses Object-Oriented Programming (OOP) to implement this design structure. This will allow the implementation of different levels of fidelity in the objects. Additionally, the user-friendly interface allows users to configure many different system architectures, through the use of icons, to allow the model to easily conduct trade-off studies.

CONSTRUCTION:

Human Participation: Required for wargaming mode; not required for analysis mode.

Time Processing: Dynamic, event-driven.

Treatment of Randomness: Stochastic and deterministic.

Sidedness: Many-sided, reactive.

LIMITATIONS: Does not model nuclear warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: 1) Using active Object-Oriented Data base Management System (OODBMS) to provide interactive gamebook for wargaming, and 2) Parallel processing technology to provide fast turnaround times.

INPUT: Data pertaining to scenario, acoustic environment data, sensor and weapon characteristics, weather, platform characteristics, tactics, command, control, and communication structure.

OUTPUT: Interactive graphical display during simulation with a multi-window environment for displaying platform status, detections, weapon performance, and statistics. In addition, a postprocessor provides users with a selection of desired MOEs for output to hardcopies and graphs to speed up analysis efforts.

HARDWARE AND SOFTWARE:

Computer:	Any workstation such as, SUN, VAXStation, DECStation, Silicon Graphics, HP, IBM PC, and Macintosh II.
Storage:	Approximately 100 MB with 16 MB RAM.
Peripherals:	Mouse.
Language:	MODSIM, CLIPS.
Documentation:	Requirement Specification, Design Document generated from CASE tools, User Manual.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Depends on the complexity of the scenario. A typical 2 CVBF scenario takes approximately 1-2 days.

CPU time per Cycle: Half hour to an hour per iteration for a 2 CVBF scenario.

Data Output Analysis: Varies with selected MOEs.

Frequency of Use: Under development, IOC in January 1992.

Users: NSWC.

Comments: MARS applies state-of-the-art technology for simulation to addresses some of the major shortcomings of existing simulation models. The objectives of MARS include:

1) Creating an environment which can be adopted or reconfigured easily to study different types of questions, considering that no single model can

address every problem in question. To achieve this flexibility, an Object-Oriented approach is taken to build an object library.

2) Using of an OOP language, software modification and enhancement are made easier while minimizing the testing time. The use of CASE tools to capture the model design will reduce the required time for updating documentation and model enhancement.

3) Ease of use and reduced learning time through the use of a user-friendly GUI and expert system.

4) Provide fast turnaround time using discrete event simulation and network computing.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: MASS - Mobility Analysis Support System.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: CINCMAC Analysis Group, Headquarters, Military Airlift Command, Scott AFB, IL 62225-5001.

POINT OF CONTACT: Lt Col John C. Marcotte, Jr., (618) 256-8713, AV 576-8713.

PURPOSE: MASS models the interactions between strategic airlifters in the military airlift system. It can be used to evaluate resourcing or capabilities of a specified airlift force structure.

DESCRIPTION:
Domain: Air and airfields.

Span: Global.

Environment: Time and space correlated observations and forecasts. Seasonal en route winds at 25,000 and 35,000 feet.

Force Composition: MAC Strategic Airlift Forces including KC-10 and Civil Reserve Air Fleet.

Scope of Conflict: Models mobility requirements of any level of conflict.

Mission Area: Airlift.

Level of Detail of Processes and Entities: Processes: Models all phases of the ground handling of airlift aircraft. In-flight processes allow air refueling, diversion, and aerial delivery. Allows attrition through predetermined probability of kill. Entities: Models performance, ground times, maintenance, and cargo capabilities of all strategic airlift aircraft (including Civil Reserve Air Fleet). Also models aircrews and their flying hour limits for military airlifters.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Most processes allow the user to select deterministic or Monte Carlo scheduling of completion and probability of occurrence.

Sidedness: One-sided.

LIMITATIONS: Does not model interaction with theater airlift or other mobility assets.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Interface with theater airlift.

INPUT: All characteristics of the entities, airfields, resources, and movement requirements.

OUTPUT: Large data files with information on aircraft and crew itineraries and resource usages.

HARDWARE AND SOFTWARE:

Computer: Currently under development on Concurrent Computer Corp. 3260 minicomputer. Also ported to Honeywell DPS-90 mainframe.

Storage: Depends on run length and detail desired.

Peripherals: None.

Language: FORTRAN.

Documentation: Limited.

SECURITY CLASSIFICATION: Unclassified, but several data sources are classified.

GENERAL DATA:

Data Base: Requires significant amount of staff contribution from within functional areas.

CPU time per Cycle: Up to several hours depending on length of scenario and amount of detail desired (I/O time).

Data Output Analysis: Relational data base management system desired.

Frequency of Use: Still under development.

Users: HQ MAC, USAF/Center for Studies and Analysis, OSD/PA&E (Mobility) are anticipated users.

Comments: N/A.

TITLE: MATADOR.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: System Assessment Group, Royal Military College of Science, Shrivenham, Swindon, Wiltshire SN6 8LA U.K.

POINT OF CONTACT: Dr. K. Wand, Swindon (0793) 785638.

PURPOSE: MATADOR is a fast analytic model used to evaluate different tank options with the context of a stochastic duel between two weapon systems.

DESCRIPTION:

Domain: Land.

Span: One-versus-one duel.

Environment: N/A.

Force Composition: One tank on each side.

Scope of Conflict: Conventional.

Mission Area: N/A.

Level of Detail of Processes and Entities: Firing cycle of each combatant broken down into detection, firing, and kill probability.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, closed form.

Treatment of Randomness: Stochastic. Exact analytic formulation of the situation is modeled. Firing times may be constant or follow Erlang distributions.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Does not model mobility of tanks.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Possibility of including guided weapon systems.

INPUT: Detection times, probability of detecting firing signature, firing time for first and subsequent shots, kill probabilities, and number of shots fired before jockeys.

OUTPUT: Probability of win for each side, probability that no kill occurs.

HARDWARE AND SOFTWARE:

Computer:	SIRIUS 1 Microcomputer, MSDOS.
Storage:	256 KB.
Peripherals:	Compatible printer.
Language:	MS-Pascal.
Documentation:	User guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Negligible. Depending upon input data, CPU time is typically a few minutes.

Data Output Analysis: Negligible.

Frequency of Use: Intermittent.

Users: RMCS.

Comments: N/A.

TITLE: MAWLOGS - Models of the Army Worldwide Logistics System.

DATE IMPLEMENTED: 1974.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Bruce Lasswell, (804) 734-1050/3449, AV 687-1050/3449.

PURPOSE: MAWLOGS is an operations support tool. It is a computerized logistics modeling system that generates models to simulate the activities and measure the behavior of a particular logistics system structure with specific policy and procedure content at a level of detail chosen by the user. Its primary focus of concern is to simulate any of a wide range of alternative logistics system structures, policies, and procedures involving maintenance, supply, transportation, and communications (and their interactions), and to measure characteristics workloads, performance, and costs.

DESCRIPTION:
Domain: Land and air.

Span: Variable.

Environment: Variable.

Force Composition: Variable level logistics system.

Scope of Conflict: Conventional, chemical, and nuclear.

Mission Area: Logistics system.

Level of Detail of Processes and Entities: The keystone of the MAWLOGS system is the model assembler, which is a program that constructs a simulation model of a system represented as a network of functional nodes whose policy and procedural content are specified in terms of modules (i.e., blocks of computer program logic representing a logistics activity or policy). The level of aggregation may be varied widely, from great to little detail, from troop unit to wholesale activities. Simulated time is treated on an event-sequence basis. Except for a shortest chain algorithm in the route selection logic of transportation, no optimizing algorithms are in the present module library.

CONSTRUCTION:
Human Participation: N/A.

Time Processing: Dynamic event-step.

Treatment of Randomness: Either stochastic, Monte Carlo or basically deterministic as required by the user.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Model assembler: description of system (model description) for which a model is to be generated including nodes, modules, and a module library (on tape). Model: policy parameter settings; resource levels; and demand characteristics such as capabilities, delay times, and constraints of system elements.

<u>OUTPUT</u>: A source code for model described in input model description.

<u>HARDWARE AND SOFTWARE</u>:

<u>Computer</u>: VAX 11/780, UNISYS 1100 series.
<u>Storage</u>: Variable.
<u>Peripherals</u>: Printer and tape drive.
<u>Language</u>: FORTRAN IV, GASP IV, and FORTRAN 77.
<u>Documentation</u>: Users' and technical documentation.

<u>SECURITY CLASSIFICATION</u>: Unclassified.

<u>GENERAL DATA</u>:

<u>Data Base</u>: N/A.

<u>CPU time per Cycle</u>: Typically one hour.

<u>Data Output Analysis</u>: Three to six months.

<u>Frequency of Use</u>: As needed.

<u>Users</u>: Proponent and BDM Corporation.

<u>Comments</u>: N/A.

TITLE: MAWM - Modular Air War Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: McDonnell Douglas Corporation, McDonnell Aircraft Company, P.O. Box 516, St. Louis, MO 63166.

POINT OF CONTACT: Mr. Marv Goldner, (314) 777-5504.

PURPOSE: The MAWM emphasizes the impact of tactical aircraft on theater air and ground combat over periods of 10 days or more. Portions of the Tactical Warfare (TACWAR) model were incorporated into the MAWM, creating a more credible ground war and allowing key benefits of second echelon and interdiction attacks by aircraft to be addressed.

DESCRIPTION:

Domain: Air and land.

Span: Accommodates any theater depending on data base; only Central Europe has been completed.

Environment: Day and night operations, defensive positions, three terrain levels, and logistics supply network.

Force Composition: Combined forces, BLUE and RED.

Scope of Conflict: Primarily conventional warfare, but some limited chemical and biological effects possible.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Different for air and ground. The smallest air element is one or more aircraft of a single type located at a single airbase. When airborne in a raid, one or more such elements can be temporarily combined and treated as a point. Aircraft performance including payload radius, repair, time-distance, and weapon system effectiveness are reflected in MAWM. Aircraft assets are allocated to offensive and defensive missions. Air combat is input as a function of mission, aircraft type, and force ratios. Aircraft sorties are suppressed through runway damage inflicted in airbase attacks. Detection and reaction to air raids, aircraft failures aircraft and airbase repairs, reserves, and replenishment are simulated. Ground forces are more aggregated than air forces; divisions that have 10 weapon types are the typical size of a unit. Attrition from threat air and ground assets, amount of C3 available to the division, and the logistic supply network influence the ground division effectiveness. A grid comprised of sectors and subdivided into battle areas shows the basic location of divisions.

CONSTRUCTION:

Human Participation: Not required; scheduled changes possible.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic, generates value as a function of an expected value.

Sidedness: Two-sided, symmetric.

LIMITATIONS: A single supply type is modeled and C3 effects are very rudimentary. Deep air interdiction is not directly modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhanced graphics and development of alternative sources of air-to-air combat attrition.

INPUT: Air-to-air attrition tables, aircraft and weapon system performance and effectiveness tables, and ground and supply data.

OUTPUT: Several reports including summary, 6 air war reports, and 10 ground war reports. Reports taken at preset times and/or end of each day.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX computer with a VMS operating system.
Storage:	10,000 blocks (5 MB).
Peripherals:	Minimum requirements: 1 terminal, 1 disk pack.
Language:	FORTRAN Extended.
Documentation:	Draft users guide plus computer documentation files for all input values and calling sequences.

SECURITY CLASSIFICATION: N/A.

GENERAL DATA:

Data Base: Several man-months for a completely new data base. Adaptation of an existing one, (e.g., for a new aircraft type) would be less than one week.

CPU time per Cycle: Approximately 5 minutes for 10 days of combat on a VAX.

Data Output Analysis: Minimal graphics available; e.g., drawdown, sorties flown, and exchange ratios.

Frequency of Use: Varies, but has been used up to 30 runs per day in final study phase.

Users: MCAIR, DAC, and IDA.

Comments: Used on the Northrop MCAIR ATF program as well as other IRAD/CRAD studies at MCAIR.

TITLE: MBCS - Minefields and Barriers Combat Simulation.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: CA4 Division, RARDE, Fort Halstead.

POINT OF CONTACT: N. Roberts, RARDE ext 2289.

PURPOSE: Research and Evaluation of weapon systems effectiveness.

DESCRIPTION:
Domain: Land.

Span: Local (typically up to 10km front).

Environment: Digitized terrain, representing relief, vegetation and man-made cover. 100m resolution.

Force Composition: Heterogeneous direct fire units, and "off-table" artillery.

Scope of Conflict: Conventional.

Mission Area: Direct fire battle.

Level of Detail of Processes and Detail: Individual vehicles and GW teams represented. Location and state of all relevant mines also represented individually. Direct fire attrition is modeled in detail to the individual firing and impact. Each mine encounter explicitly modeled. Movement is along preplanned routes, with speed and acceleration governed by a simple mobility algorithm.

CONSTRUCTION:
Human Participation: Not required or permitted.

Time Processing: Event sequenced.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Limited number of GW types represented (i.e., only CLOS and ripple-fire Passive Homer). No infantry or helicopters represented. No C3I.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: 1) Vehicle characteristics (weight, power, dimensions, minefield countermeasures fitted); 2) Weapon characteristics (range, time of flight); 3) Minefield and barrier data (location, mine density, etc.); 4) Orbat, deployment, routes, orders; 5) Probability data (mine lethality, hit and kill probabilities for DF systems, artillery and APGMs).

OUTPUT: 1) Killer/Victim tables, by replication and averaged; 2) Firer/Target tables; 3) Shots/Kills by range; 4) Mine encounter and result statistics; 5) Event trace (i.e., blow-by-blow account of the battle).

HARDWARE AND SOFTWARE:
Computer(OS): VAX/VMS.
Storage: 70MB (130,000 Blocks).
Peripherals: No special requirements.
Language: FORTRAN IV, reconditioned to FORTRAN 77.
Documentation: User Guide, Programmer's Guide, Model Definitions.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Preparation: Several weeks.

CPU time per Cycle/Data Output Analysis: LOS Preprocessor: 50 CPU hours; Preprocessor (exc LOS): 2 CPU hrs; Simulation: 1 1/4 hours per replication for 30 minute battle; Analysis package: minimal. N.B. Timings are based on a complex main defensive action scenario.

Frequency of Use: Rare.

Users: CA4 Division RARDE. AMSAA (Aberdeen Proving Ground) has a version which differs in several respects, specifically artillery and allowed size of forces.

TITLE: MCM-CTDA - Mine Countermeasures Commander's Tactical Decision Aid.

DATE IMPLEMENTED: October 4, 1990.

MODEL TYPE: Analysis.

PROPONENT: Mine Warfare Command, NAVSTA BLDG NS-1, Charleston, SC 29408-5500.

POINT OF CONTACT: Mr. Joseph Mattingly, Code N4C (803) 743-5405, AV 563-5405.

PURPOSE: MCM-CTDA is an operational support tool designed for the MCM Commander's staff to provide the capability for rapidly and accurately evaluating, analyzing, and reconstructing an MCM operation. This capability provides the operational commander with the information necessary to schedule MCM assets, to modify tactical procedures in a timely manner, and to report status of the operation to higher authority.

DESCRIPTION:

Domain: Sea and undersea.

Span: Local.

Environment: All environmental data is implicitly specified through values users assign during MCM scenario specification.

Force Composition: Naval mines, mine countermeasures vehicles (MCMVs) and EOD.

Scope of Conflict: Conventional.

Mission Area: Sea control.

Level of Detail of Processes and Entities: MCM-CTDA first requires the user to define the MCM scenario. This includes the geographical positions of Q-routes (transit routes), threat mine types expected in each established route or route segment and effectiveness parameters for MCM systems for a specified mine type in a given location. As Situation Reports (SITREPS) are received from MCMVs and EOD units their effort is input. Effort is defined in terms of a MCM system operating from a starting point to an ending point along or within an established route. The automated assessment essentially balances the books by applying MCM effort against the expected threat. Reports are created, which estimate the cumulative clearance attained for each threat mine type, by Q-route or segment.

CONSTRUCTION:

Human Participation: Required. MCM-CTDA requires interactive input, to first build the MCM scenario, and throughout the operation to enter data from SITREPS.

Time Processing: Dynamic, Closed form.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, asymmetric. One side nonreactive.

LIMITATIONS: Math routines contained in MCM-CTDA can only work with routes vice areas. All MCM effort applied must be in parallel tracks to route. Changing locations of routes after start of operation can require significant manual manipulation of data.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporate navigation co-calibration; develop traffic casualty algorithms; integrate threat and casualty routines; improve graphics for Mine-like Object Bookkeeping and MCM Assessment routines; convert preliminary umpiring and exercise routines to the PC; interface to Route Survey Data Management System, MCM planning, and environmental data routines; display details of selected areas; project clearance, threat, and casualties; provide reconstruction routines; improve method of estimating mine prosecutions; add exercise analysis for multi-ship count mine; develop detailed minehunting analysis; and add war game.

INPUT: Data describing operational plans (intended track, mining threat, MCM system capabilities, traffic, route weighting, navigation, MCM assets), MCM unit daily SITREPS, nature and position of mines and mine-like objects, and mission prosecution fraction.

OUTPUT: Screen display and printed output of user input values and reports from the assessment analysis as well as queries into the Mine-like Object data base.

HARDWARE AND SOFTWARE:

Computer(OS):	IBM-Compatible PC (MS-DOS).
Storage:	10M bytes.
Peripherals:	Interactive keyboard, monitor and printer.
Language:	ANSI Standard FORTRAN 77; Code substantially conforms with COMINEWARCOM FORTRAN Programming Standard. Program links to a library containing screen interface routines written in Microsoft C.
Documentation:	Introduction to the MCM-CTDA Computer Programs and Software User's Manual for the Mine Countermeasures Commander's Tactical Decision Aid MS-DOS Version 1.0. The software contains some online help.

SECURITY CLASSIFICATION: Program is unclassified. Data input from actual operation or exercise is generally confidential; therefore, files maintained on disk and reports are same classification level.

GENERAL DATA:

Data Base: 30 Minutes.

CPU time per Cycle: Automated assessment routine can require up to a hour to run depending on complexity of MCM scenario and number of SITREPS.

Data Output Analysis: Minutes.

Frequency of Use: Daily during each MCM exercise or operation.

Users: MCM Commander's staff.

Comments: None.

TITLE: MCP - Maritime Campaign Program.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Operations Research Division, SHAPE Technical Centre, P.O. Box 174, 2501 CD The Hague, The Netherlands.

POINT OF CONTACT: Mr B. Lehmann, (70) 314 23 09.

PURPOSE: The MCP is used to analyze maritime force structure options, as well as to evaluate concepts of operations and the impact of technological trends.

DESCRIPTION:
Domain: Undersea, surface and maritime air; limited land targets.

Span: Global geography can be defined, theatre level conflicts usually studied.

Environment: Maritime operations take place in discrete sea areas defined by Voronoi polygons with associated environmental degradation factors.

Force Composition: Individual ship or Task Group, individual aircraft.

Scope of Conflict: Conventional warfare, limited nuclear damage effects.

Mission Area: ASW, ASuW, AAW, Maritime Air, Mine Warfare.

Level of Detail of Processes and Entities: Individual ships and groups carry out maritime operations, aircraft from carrier and land airbases carry out discrete and continuous air tasks, weapons stocks monitored.

CONSTRUCTION:
Human Participation: Optional interactive mode where players can interrupt simulation and change campaign plans for single replication.

Time Processing: Dynamic discrete event-based simulation.

Treatment of Randomness: Stochastic detection and engagement algorithms.

Sidedness: Two-sided, symmetric.

LIMITATIONS: ASW more developed than ASuW, limited mine counter measures, logistics constraints accounted for in operations schedule.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Operations in confined waters, false sonar contacts, damage function, attack policies, early warning.

INPUT: Data files specify geography, sensors, weapons, units, groups, orders, air allocations, engagement control parameters and statistics.

OUTPUT: Graphical display of forces in time, statistics tables on attrition, air activity and weapon firings.

HARDWARE AND SOFTWARE:

Computer:	VAX running VMS.
Storage:	15 MB.
Peripherals:	Line printer, VT320 terminal, SYGMEX graphics terminal with color printer.
Language:	FORTRAN.
Documentation:	Conceptual papers, draft user manual.

SECURITY CLASSIFICATION: Restricted source code, data sets usually classified.

GENERAL DATA:

Data Base: Four month effort for new data base, then a few weeks for new scenarios.

CPU time per Cycle: 30 CPU minutes (VAX 8700) for 100 replications of 30 days with 500 naval units.

Data Output Analysis: Full event trace and tabular summary statistics; no direct data plots.

Frequency of Use: Study dependent.

Users: SHAPE Technical Centre, DOAE (UK).

Comments: Single model version.

TITLE: McPTD - RCS Computation Based on Physical Theory of Diffraction.

DATE IMPLEMENTED: December 1990.

MODEL TYPE: Analysis.

PROPONENT: Electromagnetic Code Consortium.

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: McPTD performs high frequency radar cross section (RCS) computations based on the physical theory of diffraction.

DESCRIPTION:

Domain: N/A.

Span: Individual.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: McPTD is used to perform far-field, single-bounce RCS modeling. It allows the user to construct many geometric shapes such as flat and curved plates, cones, cylinders, ogives, ellipsoids, pies, and wedges. McPTD also allows for the modeling of cavities and shadowing. Up to twenty layers of uniform or nonuniform coatings described by complex or plasma parameters can be modeled.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: N/A.

LIMITATIONS: McPTD can only be used to compute single bounce RCSs; there is no component interaction. Other software packages are required to produce graphical output.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Inputs include the number of objects modeled parameters defining object shape and coating (if present), frequency, and incident and observation angles.

OUTPUT: McPTD produces RCS tables.

HARDWARE AND SOFTWARE:

Computer: VAX, Cray, SUN, Silicon Graphics, MacIntosh, IBM PC.
Storage: 1.2 MB.
Peripherals: N/A.
Language: FORTRAN 77.
Documentation: McPTD User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: MEDEVAC - Medical Evacuation Model.

DATE IMPLEMENTED: 6 September 1990.

MODEL TYPE: Analysis.

PROPONENT: USACASCOM.

POINT OF CONTACT: Gerard Petet, (804) 734-3063 or Larry Bands, (804) 734-1621.

PURPOSE: MEDEVAC was designed specifically to develop Manpower Requirements Criteria (MARC) factors for air and ground Medical Evacuation personnel throughout the theater (FLOT to EAC).

DESCRIPTION:
Domain: Land and air.

Span: Theater.

Environment: Models day and night, and various terrain conditions.

Force Composition: Blue Force only.

Scope of Conflict: Dictated as patient workload.

Mission Area: Common Ground/Air Evacuation Procedures.

Level of Detail of Processes and Entities: The model simulates individual patient entitles evacuated by individual air and/or ground ambulance entities. Patients are generated (based on input) at each level and are evacuated from each level to the next higher level by air or ground ambulance (determined by any of 9 patient categories) when the ambulance is available.

CONSTRUCTION:
Human Participation: Not required/not permitted during execution.

Time Processing: Dynamic/event-step.

Treatment of Randomness: Stochastic based on empirical distributions for patient concentration, category, and disposition.

Sidedness: One-sided.

LIMITATIONS: Only 5 distinct types of air and 5 distinct types of ground ambulances may be played concurrently (unlimited quantity of each type). There is no warm-up period. Limited to division slice or theater. Host nation support (ground ambulance) available at corps support hospital and communications zone hospital only. Nine collection point nodes and battalion level. Three brigade support area nodes. One division support area node. One corps support hospital. One communications zone hospital. No MASH played. No ambulance exchange point played.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

HARDWARE AND SOFTWARE:
Computer: Designed to run on a VAX with VMS.
Storage: 3 MEG.
Peripherals: Printer, VT.
Language: SLAM/FORTRAN.
Documentation: User's guide available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Patient workload development and ambulance maintenance time may require several man-weeks for development; several man-days to input.

CPU time per Cycle: Approximately 30 CPU min for 30 simulated days given no severe queuing of patients (200+) awaiting evacuation at any level.

Data Output Analysis: Postprocessor provides key operational and queuing data by ambulance, patient category, and level.

Users: Academy of Health Sciences, San Antonio, TX.

Comments: None.

TITLE: MEM - Mission Effectiveness Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: HQ Space Division, CNCIS, Los Angeles AFB, P.O. Box 92960, Los Angeles, CA 90009-92960.

POINT OF CONTACT: Lt. Dale Brown, (213) 643-0036, AV 833-0036.

PURPOSE: The Mission Effectiveness Model (MEM) simulator is a ballistic missile defense architecture analysis tool. It models the major functions of a strategic defense system operating against a ballistic missile threat during a simulated end-to-end scenario. The model is designed specifically to help intersegment system design options. It can analyze the performance sensitivity of proposed architectures to their critical design parameters. It can also be used to help evaluate or derive functional system requirements.

DESCRIPTION:

Domain: Terrestrial, air, and space.

Span: Global.

Environment: Models air and space operations including atmospheric effects on missiles, space environment, and orbital/trajectory parameters.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Primarily nuclear ballistic missiles for the offensive forces and non-nuclear (directed energy, kinetic energy, and neutral particle beam) weapons for the defensive forces.

Mission Area: Ballistic missile defense and some aspects of space control.

Level of Detail of Processes and Entities: Models individual weapons (e.g., space-based interceptors, ballistic missiles, and ground-launched interceptors) throughout their flights and engagements. Models communications, battle management, satellite attrition, perceived and actual engagement results, and sensor performance.

CONSTRUCTION:

Human Participation: Not required after input/output file selection.

Time Processing: Dynamic, time- and event-step. Progresses through events at user-specified time increments.

Treatment of Randomness: Deterministic except ASAT engagement, which can be either deterministic or stochastic with Monte Carlo determination of results.

Sidedness: Models one-sided ballistic missile defense and ground-based ASAT operations.

LIMITATIONS: Currently no option to assess Monte Carlo weapon kill assessment for non-ASAT engagements.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Two-sided, symmetric, reactive ballistic missile defense and space control simulator with survivability enhancements (expected October 1988).

INPUT: DEFSYS module defines all elements of space and ground systems and simulation run parameters. THREAT module defines all elements of threat scenario and forces.

OUTPUT: Computer printouts, plot raw data postprocessors and graphical analysis.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780 or better, SUN family workstations, PC (Graphics).
Storage:	3500 lines of FORTRAN 77.
Peripherals:	None required; graphics terminal for data postprocessor graphics or line printer for report review.
Language:	FORTRAN 77.
Documentation:	User's Manual, Technical Reference Manual, and Validation & Verification Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Preparation and population of large data bases can take several man-years.

CPU time per Cycle: Depends on data base size and player configuration; large simulations can take one hour of CPU time to process one hour of ballistic missile defense and ASAT operations.

Data Output Analysis: Postprocessor aids in analysis of output and produces graphical display and hardcopies of new data.

Frequency of Use: Varies by organization, but is used at least monthly by those listed below.

Users: AF Space Division; The Joint Staff/J-8 NFAD; SDIO National Test Bed.

Comments: MEM is managed by the DoD MEM Configuration Control Office, USAF HQ Space Division/CNCIS. It is continually upgraded based on priorities established by the MEM Configuration Control Office.

TITLE: MEM - Multiple Engagement Module.

DATE IMPLEMENTED: November 1986.

MODEL TYPE: Analysis.

PROPONENT: Joint Strategic Target Planning Staff (JSTPS), Offutt AFB, Omaha, NE 68113.

POINT OF CONTACT: Joint Strategic Target Planning Staff (JLAA), LT Zumbar, USN, AV 271-3997.

PURPOSE: MEM is used to assess attrition of the ICBM/SLBM portion of the SIOP visible to Soviet ballistic missile defenses. MEM is a time-sequenced program that steps through the engagement in chronological order: entering vehicles, moving them along their trajectories, determining radar acquisitions, computing intercept conditions, launching interceptors, and processing the nuclear detonations that result. Measures of merit computed include the probability of penetration (PTP) by individual sortie basis by weapon systems and by targets. MEM also concerns itself with ABM fratricide avoidance, chaff and blackout, radar data processor overload, ABM defense doctrines, and nuclear effects.

DESCRIPTION: MEM is two-sided, stochastic model that deals with land and sea forces. It was designed to be executed for individual sorties; it can be manipulated for 6 radar types, 30 radars, 5 ABM types, 15 weapon types, and 10 booster types. MEM was primarily designed to operate on the individual sortie or weapon system level. It can range from 1000 exoatmospheric objects to 250 total targets. MEM is a time-step model that uses Runge-Kutta numerical integration and spherical rotating earth equations of motion.

Domain: Air and space.

Span: Global strategic nuclear warfare.

Environment: N/A.

Force Composition: Joint forces; BLUE and RED.

Scope of Conflict: Strategic nuclear.

Mission Area: Tactical warning and assessment.

Level of Detail of Processes and Entities: Models the individual reentry vehicle and defensive missile.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, one side nonreactive.

LIMITATIONS: The number of targets that can be attacked make it too small for SDI, and the long detailed run time would require a supercomputer if more targets were used.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Weapons data files, nuclear effects data files, defense data files, and offensive/target data files.

OUTPUT: Hardcopy reports of an attrition summary, launch summary, launch analyses, PTP summary, radar load plots, engagement history, battle summary, and common block contents.

HARDWARE AND SOFTWARE:
Computer: Vax 8700, IBM 3033, UNIVAC 1100/61.
Storage: N/A.
Peripherals: VMS, MVS, ECL.
Language: FORTRAN.
Documentation: User's manual, December 1983.

SECURITY CLASSIFICATION: Top secret.

GENERAL DATA:
Data Base: 1 month.

CPU time per Cycle: 3 hours.

Data Output Analysis: 2 weeks.

Frequency of Use: Once a year to start war game.

Users: JSTPS, OP-654, JCS (J-8), DIA.

Comments: Linked to System for Integrated Nuclear Battle Analysis Calculus (SINBAC) for use in the SIOP/RISOP war games.

TITLE: METRIC V.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis (but has been used as an exercise driver).

PROPONENT: OSD/Net Assessment, Washington, DC.

POINT OF CONTACT: Mr. Charles D. Burdick (703) 848-7388.

PURPOSE: METRIC V is a large scale warfighting model primarily used as a research and evaluation model dealing with theater level force capability and effectiveness. It has also been used for combat development of new doctrine and tactics. The model has the ability to allow human control of any C2 node and has been used as a CPX driver.

DESCRIPTION:

Domain: Air, land, sea, undersea, space.

Span: Variable regional up to global. Can play multiple theaters simultaneously.

Environment: Includes weather, day/night, and terrain (roads, rivers, oceans, forests, mountains, cities, trafficability).

Force Composition: Combined and Joint Forces.

Scope of Conflict: Conventional, chemical, nuclear and mixed.

Mission Area: All conventional missions including Deep Operations and some LIC.

Level of Detail of Processes and Entities: All ground and air missions represented along with some naval operations. All indirect fire, surface-to-air, air-to-surface, and air-to-air engagements are explicitly modeled with Monte Carlo probability of kill (situation dependent). Ground direct fire is Lancaster-based with adjustable time-steps. Logistics (supply, maintenance, and transportation) are explicitly modeled and integrated with combat operations. Model separates perceptions from ground truth with decisionmaking based on perceptions. Highly automated operations and movement. Seven levels of C2 with explicit message flows.

CONSTRUCTION:

Human Participation: Can be used without humans in analysis mode (interruptable) or Man-In-The-Loop (for decisions). Does not wait for decisions, but can be paused.

Time Processing: Both event- and time-stepped. Down to 1 minute time-steps (settable). Event-steps are automatic with less that 1 second resolution.

Treatment of Randomness: Stochastic, Monte Carlo for most engagements. Some deterministic processes in sensor detection and area weapons.

Sidedness: Two-sided, asymmetric, both sides reactive. Each side can include forces with different doctrines, thresholds, weapons, and support capabilities.

LIMITATIONS: Space operations limited to sensors, ICBMs, and ABMs. Only a few automated operations now for Navy. Lowest resolution cell is 1.25Km hex.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The METRIC V data base is being expanded to include worldwide forces and scenarios (currently Europe CFE, SWA, Lebanon, and the Philippines have been applied).

INPUT: User defined notional or real world data on available forces, force structures and assets, vulnerabilities and capabilities, ports and bases, and terrain. World Data Bank II for background and map generations. Operations Orders (OPORDS), Air Tasking Orders (ATOs), and Naval Tasking Orders for designated forces.

OUTPUT: Report printouts, color graphic map displays, and raw data.

HARDWARE AND SOFTWARE:

Computer:	Control Data Corporation CYBER 900 with user interface on Zenith or any IBM Compatible Terminal with at least 640K RAM. Recently ported to SUN Spacestation 1 or 2 with 16MB or more RAM.
Storage:	Variable, recommend one gigabyte or more.
Peripherals:	Printer, Tape Drive, Microcomputer, Microcomputer Printer, Mouse.
Language:	Basic Model: FORTRAN (CYBER and SUN); Operating System: (CYBER-NOS/VE) (SUN-UNIX); Common User Interface: FORTRAN/ CYBIL (CYBER); Terminal Control Subsystem: PASCAL (ZENITH and IBM); User Input/Output: SMART Software Package (Zenith and IBM); Data Base: (CYBER-IM/DM) (SUN-TBD).
Documentation:	Game Users Manuals, System Specifications, Maintenance Manuals, Data Dictionary, Data Base Specifications, and others.

SECURITY CLASSIFICATION: Code is unclassified.

GENERAL DATA:

Data Base: New data bases require up to six staff months, modifications can be done in days or weeks depending on extent.

CPU time per Cycle: Variable depending on scenario size. Runs up to sixty times faster than real time.

Data Output Analysis: Graphics and DBMS.

Frequency of Use: Daily.

Users: OSD/Net Assessment, Washington, DC, U.S. Army TPIO, Ft. Leavenworth, KS.

Comments: METRIC V is closely related in architecture to the Army CORBAN and USAF Suppressor models. METRIC V has global scope but maintains engagement level of detail.

TITLE: METRIC VI.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis (but has been used as an exercise driver).

PROPONENT: OSD/Net Assessment, Washington, DC.

POINT OF CONTACT: Mr. John M. Milam, (703) 848-7749.

PURPOSE: METRIC VI is a detailed warfighting model primarily used as a research and evaluation tool for theater level force capability, effectiveness and sensitivity analysis. It combines maneuver, C^3I, logistics, and integrated air and ground operations. It has also been used for combat development of new doctrine and tactics.

DESCRIPTION:

Domain: Air, land, and sea.

Span: Variable from battalion up to theater. Can play multiple theaters simultaneously.

Environment: Includes weather, day/night, and terrain (roads, rivers, oceans, forests, mountains, cities, trafficability).

Force Composition: Combined and Joint Forces.

Scope of Conflict: Conventional, Chemical, Nuclear, and Mixed.

Mission Area: All conventional missions, including Deep Operations and LIC.

Detail of Level of Processes and Entities: All ground and air missions are represented along with some naval operations. All indirect fire, surface-to-air, air-to-surface, and air-to-air engagements are explicitly modeled with Monte Carlo probability of kill (situation dependent). Ground direct fire is attrition based with adjustable time-steps. Logistics (supply, maintenance, and transportation) are explicitly modeled and integrated with combat operations. Model separates knowledge from ground truth with decisionmaking based on battlefield perceptions. Highly automated operations and movement. Several levels of C^2 with explicit message flows.

CONSTRUCTION:

Human Participation: Fully automated in Analysis Mode (interruptable) or Man-In-The-Loop (for decisions). Does not wait for decisions, but can be paused.

Time Processing: Both event- and time-steps (settable). Event-steps are automatic with less than one second resolution.

Treatment of Randomness: Stochastic, Monte Carlo for most engagements. Some deterministic processes in sensor detection and area weapons.

Sidedness: Two-sided, asymmetric, both sides reactive. Each side can include forces with different doctrines, thresholds, weapons, and support capabilities.

LIMITATIONS: Only a few automated operations now for Naval play. Lowest resolution cell is 1.25Km hex.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The METRIC VI data base is being expanded to include worldwide forces and scenarios (currently Europe Post-CFE, SWA, and the Philippines scenarios have been analyzed).

INPUT: User defined national or real world data on available forces, force structures and assets, vulnerabilities and capabilities, ports and bases, and terrain. World Data Bank II for background map generations. Operations Orders (OPORDS), Air Tasking Orders (ATOs), and Naval Tasking Orders for designated forces.

OUTPUT: Customized report printouts, color graphic map displays, and raw data.

HARDWARE AND SOFTWARE:

Computer:	SUN SparcStation 1 or 2 with 16MB or more RAM. Also Control Data Corporation CYBER 900 with user Interface on Zenith or any IBM Compatible Terminal with at least 640K RAM.
Storage:	Variable, Recommend One Gigabyte.
Peripherals:	Printer, Tape Drive, Microcomputer, Microcomputer Printer, Mouse.
Language:	Basic Model: FORTRAN (Sun and Cyber). Operating System: (SUN-UNIX) (CYBER-NOS/VE). Common User Interface: FORTRAN/CYBIL (CYBER). Terminal Control Subsystem: PASCAL (Zenith and IBM). User Input/Output: SMART Software Package (Zenith and IBM). Data Base: (SUN-TBD) (CYBER-IM/DM).
Documentation:	Game Users Manuals, System Specifications, Maintenance Manuals, Data Dictionary, Data Base Specifications, and others.

SECURITY CLASSIFICATION: Code is unclassified.

GENERAL DATA:

Data Base: New data base development is scenario dependent, modifications can be done in days or weeks depending on extent.

CPU time per Cycle: Variable depending on scenario size. Runs up to one hundred times faster than real time.

Data Output Analysis: Graphics, DBMS, Postprocessor Reports.

Frequency of Use: Daily.

Users: OST/Net Assessment, Washington, DC.

Comments: METRIC VI is closely related in architecture to the Army CORBAN and USAF Suppressor models. METRIC VI has theater scope but maintains engagement level of detail.

TITLE: MICA - Multiple Launch Rocket System (MLRS) Interactive Computer Aid.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education (also used for analysis of decision processes).

PROPONENT: Centre for Operational Research and Defence Analysis (CORDA), 233 High Holborn, London WC1V 7DJ, England.

POINT OF CONTACT: J.B. Taylor, CORDA, 44-1-831-6144.

PURPOSE: MICA is used primarily for individual skills development. It can also be used as an exercise driver for an individual or a command post.

DESCRIPTION:

Domain: Land.

Span: N/A.

Environment: Different "goings" can be specified by altering data controlling activity delays.

Force Composition: Nine launchers.

Scope of Conflict: Conventional warfare: typically three types of ammunition (bomblets, scatterable mines, and terminally guided submunitions).

Mission Area: Indirect artillery.

Level of Detail of Processes and Entities: The model represents the activities (movement, loading, and firing) of MLRS launchers (self-propelled launcher/loaders). The activities are driven by decisions that the user makes based on information presented to him on the status of his launcher assets and the requirements for targets to be engaged. The user also makes decisions relating to ammunition resupply.

CONSTRUCTION:

Human Participation: Required for decisions. Model can run in real time or wait for decisions and time-step on user input.

Time Processing: Dynamic, time-step (variable).

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: No representation of communications delays or end effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Conversion to "C" programming language and amendments to user interface. Extensions to the models to make possible their use as command post exercises and to provide the core systems with more detailed training tools are planned. The use of the aids as tools for analysis of command decisions is also planned.

INPUT: Target stream defining arrival times, size, timeliness information, and type of ammunition required. Initial location of launchers (by 6-figure grid coordinates) and launcher data (speeds, etc.).

OUTPUT: Detailed events log of launcher activities and decisions made; summary statistics tables.

HARDWARE AND SOFTWARE:

Computer:	IBM PC-Compatible, DOS 3.
Storage:	Approximately 500 Kbytes.
Peripherals:	None required, but a printer is useful for output.
Language:	Compiled Turbo BASIC. Currently converting to Microsoft "C".
Documentation:	Extensively documented, including full descriptions, specifications, and detailed user guide.

SECURITY CLASSIFICATION: UK Restricted.

GENERAL DATA:

Data Base: Target stream scenarios require several man-days to set up.

CPU time per Cycle: N/A.

Data Output Analysis: Training performed during use of model; analysis of performance possible through output statistics.

Frequency of Use: Used regularly for training of officers.

Users: UK Royal School of Artillery, Larkhill; Army Personnel Research Establishment (APRE); 1 (BR) Corps, Germany (39th Heavy Regiment).

Comments: The MLRS Interactive Computer Aid is one of a family of command and control computer aids intended to give commanders an appreciation of the difficulties they are likely to encounter in controlling assets in complex scenarios. Further work is being performed to develop similar aids for use in casualty evacuation and civilian disaster planning.

TITLE: MICM - Maritime Integrated Campaign Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: North Atlantic Treaty Organization, Supreme Allied, Commander, Atlantic, Norfolk, VA 23511-6696.

POINT OF CONTACT: Mr. Colin Wright, Code C-A2, AVN 565-3388; Commercial (804) 445-3388.

PURPOSE: MICM is designed primarily as a research and evaluation tool, dealing with force capability and requirements, for resources planning. However, it can address all aspects of research and evaluation.

DESCRIPTION:
Domain: Primarily combinations of sea, air and undersea. Limited use of land and space.

Span: Any theater in northern hemisphere, Gulf of Mexico east through Arabian Sea.

Environment: Coastal boundaries, other features may be implemented through parameter variations within individual circular, rectangular or sector regions of variable size.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Conventional warfare.

Mission Area: Primarily sea control (ASW, AAW, ASUW, MIW, STW) and logistics. Land bases may be used, attacked and defended.

Level of Detail of Processes and Entities: Units (platforms) may be defined with unlimited systems and weapons, plus stores (fuel, avgas, buoys). Units belong to groups, and may be damaged and attrited. Systems may be damaged and degraded in performance. Weapons and stores may be expended and replenished. Groups move, operate and interact with friendly and enemy groups. Groups communicate with headquarters.

CONSTRUCTION:
Human Participation: Required for decisions between run segments, not required during run segments.

Time Processing: Dynamic, event-stepped model.

Treatment of Randomness: Both stochastic (direct computation of probabilities with Monte Carlo determination of result) and deterministic (generating values as functions of expected values).

Sidedness: Two-sided, symmetric model.

LIMITATIONS: Only modeled operations, actions and interactions are allowed. Maritime groups are not prevented automatically from operating on land. Blue-on-blue attacks not modeled at present.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expansion in the number of friendly action modules and in the number of interaction modules between opposing forces. Revision of documentation.

INPUT: Unit stores, weapons and systems. Composition, characteristics and initial positions of forces. Parameter values for force, unit, weapon and system performances.

OUTPUT: Composition, characteristics and current positions of forces. Weapons expended, units lost, stores used or transferred between units. Communications files. Graphics format for maps, with overlays of current positions of groups, locators, and regions.

HARDWARE AND SOFTWARE:

Computer:	IBM compatible PC, preferably at least 386, as server, running SCO XENIX and INFORMIX SQL/ESQL/C. Separate PCs (XT or higher) used as terminals for Control, Blue, Red, running DOS 3.3 or higher, plus GRAFPOINT TNET Graphics Terminal Emulation (Techtronics) software.
Storage:	20 Mb at server.
Peripherals:	Graphics Monitors for Control, Blue, Red.
Language:	"C", XENIX shell.
Documentation:	User Manuals being revised.

SECURITY CLASSIFICATION: Unclassified model.

GENERAL DATA:

Data Base: Time required varies with application.

CPU time per Cycle: Time varies with application.

Data Output Analysis: Statistical files for stores usage, units lost and weapons expended. Communications files are available. Current data base is saved.

Frequency of Use: Not yet implemented in real game.

Users: Installed at SACLANT, SHAPE Technical Center, CINCHAN and the Defence Research Agency (UK).

Comments: Model may be tested by one operator and used by any number of Control, Blue and Red personnel.

TITLE: Micro FASTALS.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Mr. Raymond McDowall, (DSN) 295-0027 or (301) 295-0027.

PURPOSE: The objective of Micro FASTALS is to develop the balanced support force requirements for a specified combat force. Micro FASTALS is used primarily for force planning studies and analysis involving a small force in a contingency type operation. Micro FASTALS was developed from the larger FASTALS model and designed to run on a personal computer using a spreadsheet format.

DESCRIPTION:
Domain: Land.

Span: Each run accommodates one theater with a specified combat force in a combat scenario.

Environment: Theater dependent.

Force Composition: Specified by study sponsor and used to generate requirements for Army Logistical units.

Scope of Conflict: N/A.

Mission Area: Micro FASTALS is a deterministic computer program that was developed to generate the Army support requirements that result from a given combat simulation in a small theater.

Level of Detail of Processes and Entities: Support requirements are generated for each unit type (functional area) including engineer, chemical, medical, transportation, ordnance, quartermaster, etc., by Standard Requirements Code (SRC). The workload requirements needed to sustain the forces are also generated and displayed. Workloads include maintenance, construction, supply consumption, transportation, patient care, personnel replacements, other.

CONSTRUCTION:
Human Participation: All inputs are developed by functional area analysts prior to model execution. No interaction is permitted during model execution.

Time Processing: Dynamic, one time period.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Generalized theater network (single region); no time-phasing of requirements; no attrition to combat/support units, single movement of units and supplies from point of arrival in theater to destination.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model will be expanded to handle 700 units (up from 300) and be able to generate a time-phased troop list similar to the larger FASTALS model.

INPUT: The following data base in magnetic tape form are used: Military Traffic Management Command weights file, Army MARC Maintenance Data Base, Force Accounting System unit data, and Consumption factor data (provided on floppy disks) from the U.S. Army Logistics Center.

OUTPUT: Force listing is in the form of a time-phased troop list indicating unit requirements by SRC.

HARDWARE AND SOFTWARE:

Computer:	IBM AT or equivalent.
Storage:	1.5 megabytes.
Peripherals:	Standard or high density disk drives.
Language:	LOTUS 1-2-3.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:

Data Base : One man-week or more depending on size of force and complexity of theater being evaluated.

CPU time per Cycle: Five (5) minutes.

Data Output Analysis: Two (2) days or more depending upon theater.

Frequency of Use: Used approximately 10 times per year for Quick Reaction Analyses.

Users: U.S. Army Concepts Analysis Agency; U.S. Army Logistics Center; U.S. Army Logistics Evaluation Agency.

Comments: This model has been used for 3 years to develop the support force requirements for the Army.

TITLE: Micro SAINT.

DATE IMPLEMENTED: February 1986.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Medical Research and Development Command, Walter Reed Army Institute of Research, ATTN: CMPAT, Washington, DC 20307-0001.

POINT OF CONTACT: Dr. Frederick Hegge, (301) 576-1671.

PURPOSE: Micro SAINT is a research and evaluation tool that deals with both systems effectiveness and systems development. It is a general purpose modeling tool designed to facilitate model development. It has been structured to facilitate the development of weapon system performance libraries and data bases for combat performance simulation.

DESCRIPTION:
Domain: Abstract; Micro SAINT can be used to model systems and interactions among systems in all domains.

Span: Primarily regional, local, or individual.

Environment: Determined by the user.

Force Composition: Primarily component or element, although it could be applied to broader problems.

Scope of Conflict: N/A.

Mission Area: Determined by the user; not inherently constrained by the model.

Level of Detail of Processes and Entities: Determined by the user.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic (Monte Carlo) or deterministic (user-selectable for any given run).

Sidedness: One-sided or two-sided.

LIMITATIONS: No more than 400 uniquely defined activities per model (although more can be defined on the VAX/VMS version). Note that activities performed many times only constitute one activity even if performed by different entities.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Version for the Macintosh under development; customized user interfaces and system performance libraries for specific DoD applications being built; and more sophisticated modeling features being added.

INPUT: Scenario, activities performed by each system type, and performance characteristics of systems.

OUTPUT: Raw data in ASCII files, as well as data plots, histograms, and descriptive statistics for any variables of interest.

HARDWARE AND SOFTWARE:

Computer: IBM PC (MS DOS) and VAX (VMS).
Storage: 20 MB hard disk.
Peripherals: IBM graphics-compatible computer.
Language: No programming language required (one is built-in).
Documentation: N/A.

SECURITY CLASSIFICATION: None.

GENERAL DATA:

Data Base: Depends upon the complexity of scenario. Models with only a few systems, each with under 20 activities, can be constructed in roughly one day.

CPU time per Cycle: This cannot be defined since model is event-driven.

Data Output Analysis: Roughly one hour to print all data and statistics.

Frequency of Use: Unknown.

Users: Army Research Institute, Walter Reed Army Institute of Research; Naval Aeromedical Research Laboratory; and a number of contractors.

Comments: Micro SAINT has only been in use for several years, but has generally been received positively by its users.

TITLE: MIDAS - Macintosh Interactive Display and Analysis System.

DATE IMPLEMENTED: Current version: April 1989.

PROPONENT: CA1 Division, RARDE, Fort Halstead, Sevenoaks, Kent, England.

POINT OF CONTACT: PO/EWS, CA1 Division, RARDE, Fort Halstead, Sevenoaks, Kent, England. Tel: Knockholt (0959) 32222, Ext 2353.

PURPOSE: MIDAS is a system designed to display the output from EMSA, DAP, and the Electronic Warfare Simulation (EWS). It can also be used to generate static scenarios for the EWS.

DESCRIPTION:

Domain: Land.

Span: Terrain data base currently restricted to Central Europe 1(BR) Corps region, although could in principle cover any region in any theater.

Environment: Aggregated terrain (500-meter resolution). Spot height and cover data displayed from EWS terrain data base. Roads and rivers displayed via a digitized map.

Force Composition: RED and BLUE forces.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: DAP is designed to display unit locations, identities, and communications configurations from EMSA, DAP, and EWS output. Data may be displayed on individual units, groups of units meeting specified criteria, and particular types of communications links.

CONSTRUCTION:

Human Participation: Required.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: RED and BLUE.

LIMITATIONS: Cannot display emitter data from the EMSA, EWS, or DAP.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Inclusion of emitter data, modifications to the user interface, and improvements to the scenario generation features.

OUTPUT: Output from EWS, EMSA, and DAP.

OUTPUT: On-screen display, printout, or computer file of unit identities, locations, and communications links.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a Macintosh II, IIx or IIcx computer with the Apple operating system.
Storage:	Minimum requirements: 2 MB main memory and 20 MB hard disk.
Peripherals:	Minimum requirements: one 19-inch color monitor and one printer.

Language: MPW Pascal.
Documentation: User guide, system description, and programmer guides.

SECURITY CLASSIFICATION: Classified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: Output file for input to EWS, and output files for input into Macintosh spreadsheet.

Frequency of Use: As required.

Users: RARDE.

Comments: N/A.

TITLE: MIDAS - Model for Intertheater Deployment by Air and Sea.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: Studies, Concepts and Analysis Division, J-4, The Joint Staff, The Pentagon, Room 2E827, Washington, DC.

POINT OF CONTACT: Mr. Thomas C. Currier, (703) 697-6110, DSN 227-6110.

PURPOSE: MIDAS provides the Joint Staff (J-4) planners with an intertheater deployment model that simulates movement of combat and support units as well as sustainment for scenarios ranging from small contingencies to worldwide multitheater operations. It is a research and evaluation tool that assesses the capability of the mobility force. As such, it allows for detailed resource planning and provides for comparisons of mix effectiveness of various lift forces.

DESCRIPTION:

Domain: Land, Sea, Air.

Span: Single theater to Simultaneous Multi-Theater.

Environment: N/A.

Force Composition: Limited only by the data base.

Scope of Conflict: Conventional/Unconventional as dictated by the data base and the scenario.

Mission Area: All aspects of airlift, sealift and prepositioning.

Level of Detail of Processes and Entities: Aircraft fleets and individual ships. Deploying units usually aggregated no higher than the brigade (Army/USMC) level, or the squadron (USAF) level. Capable of modeling convoying (sealift), attrition (airlift and sealift), constrained/damaged ports (airlift and sealift), staging, availability and utilization of resources (airlift and sealift), and allocation of intertheater airlift to theaters, as well as changing any of the above process parameters without notice. The model can also generate the sustainment requirements for the deployed forces, based on consumption and combat intensity profiles supplied by the services, and the closure profile achieved by the model.

CONSTRUCTION:

Human Participation: Scheduled and unscheduled changes permitted as inputs prior to simulation.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: No fixed limits of any of its parameters--dependent on hardware architecture. Does not simulate CONUS or Intratheater ground movement. Does not have a start/stop capability.

PLANNED IMPROVEMENTS AND MODIFICATIONS: User-friendly input editor planned, start/stop capability.

INPUT: Uses four major input data files: movement requirements data file, consumption rates file (if required), ship characteristics and availabilities file, and a scenario description file.

OUTPUT: Outputs normally produced in report format. AOs have a menu-driven capability of producing over 1000 graphs per simulation. Offline data base management systems allow for customized tabular and reports generation.

HARDWARE AND SOFTWARE:
Computer: IBM 3090 (OS MVS/XA) or VAX 8650 (OS VMS).
Storage: Varies, but routinely up to 500 MB.
Peripherals: User choice.
Language: PL/I.
Documentation: MIDAS Users Manual.

SECURITY CLASSIFICATION: Unclassified (without data).

GENERAL DATA:
Data Base: Data base preparation usually done by Services and can take several man-weeks.

CPU time per Cycle: Varies based on size and complexity of data base and scenario. Times range from 15 minutes to 60 minutes of CPU time.

Data Output Analysis Varies depending on complexity of problem and purpose of the simulation.

Frequency of Use: Daily during the course of major studies.

Users: OASD(PA&E), The Joint Staff (J-4).

Comments: Has been linked with SUMMITS, an intratheater mobility model in the course of a major study.

TITLE: MIDLAAM - Midlevel Allocation and Assessment Model.

DATE IMPLEMENTED: December 1989.

MODEL TYPE: Analysis.

PROPONENT: Vulnerability Analysis Branch (C312), Joint Data Systems Support Center (JDSSC). The Pentagon, Washington, DC 20301-7010.

POINT OF CONTACT: Elliott Hunter, (703) 697-7421, AV 227-7421.

PURPOSE: The MIDLAAM process is a directed set of models and procedures that collectively represent a complete mid-level strategic force allocation and assessment model. MIDLAAM performs the following functions: target data preparation and aggregation, target response function generation, arsenal preparation and maintenance, and force allocation planning.

DESCRIPTION:

Domain: Land, air, and sea.

Span: Global.

Environment: N/A.

Force Composition: Combined forces.

Scope of Conflict: Nuclear weapons.

Mission Area: Strategic nuclear missions.

Level of Detail of Processes and Entities: Individual targets are input but are aggregated into target complexes/aimpoints and target groups. Target vulnerability determines survival probability.

CONSTRUCTION:

Human Participation: Required for data preparation and scenario decisions prior to execution.

Time Processing: Static.

Treatment of Randomness: Deterministic; generates a value as a function of an expected value.

Sidedness: One-sided.

LIMITATIONS: Data preparation is extensive, and targeting background is required to fully utilize model capabilities.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improve file handling structure and enhance measures of effectiveness.

INPUT: Includes arsenal, target, and scenario data. Attack strategies are also required.

OUTPUT: Aggregated target files, detailed statistical and allocation steps, strike file, and error reports.

HARDWARE AND SOFTWARE:

Computer:	IBM 4341 operation under CMS.
Storage:	6 MB core required to run specific section of the systems.
Peripherals:	Printer, terminal (runs interactively with user), and disk storage device.

Language: FORTRAN 66.
Documentation: MIDLAAM user's guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Two to three weeks.

CPU time per Cycle: Five to 60 minutes CPU depending on file size and complexity of allocation.

Data Output Analysis: Statistical summaries and reports provide quick access to results.

Frequency of Use: Three studies per year.

Users: Office of the Assistant Secretary of Defense, International Security Policy (OASD/ISP) and Office of the Assistant Secretary of Defense, Program Analysis and Evaluation (OASD/PA&E).

Comments: N/A.

TITLE: MINDSIM - Mine Deployment Simulation Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-EN-A, P.O. Box 631, Vicksburg, MS 39181-0631.

POINT OF CONTACT: Phillip L. Doiron, (601) 634-3855.

PURPOSE: MINDSIM is used primarily to analyze the deployment performance of remotely delivered, scatterable mines in realistic terrain and environmental conditions. The model presently simulates the deployment of all U.S. scatterable mine systems and will have the capability in the near future to simulate the deployment performance of foreign scatterable mine systems. MINDSIM can be used to produce tactical decision aides for a battlefield commander.

DESCRIPTION:

Domain: Land.

Span: Based on 1:50000 scale map quadrangle.

Environment: Grid-based. Each 100m grid cell contains the terrain and environmental descriptions of the area. These terrain descriptions can include the topographic elevation; vegetation type, height, and density; soil type and moisture content; water depth, width, and velocity; urban structure height and density; and road type and width. The environmental descriptions can include the type and amount of precipitation and the snow depth.

Force Composition: Mine system assets, both BLUE and RED.

Scope of Conflict: Conventional and unconventional.

Mission Area: Mining operations.

Level of Detail of Processes and Entities: The performance of each individual mine system is simulated. The simulation is geared primarily to analyze the interactions of the mines with the terrain and environmental conditions occurring in the selected minefield areas. The minefields can be located anywhere on a 1:50000 scale map quadrangle and can be of any size up to the size of the terrain data base.

CONSTRUCTION:

Human Participation: Required to select the mine system parameters.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Does not take into account any mine system delivery errors. Mines are assumed to be placed into the designated minefield area.

PLANNED IMPROVEMENTS AND MODIFICATIONS: In the near future, foreign scatterable mine systems and the U.S. Wide Area Mine will be included. MINDSIM will be implemented on an MS DOS-based PC.

INPUT: Relevant terrain and environmental factors and mine system characteristics.

OUTPUT: Produces graphical display and tabular printouts of mine performance.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a MicroVAX computer with VMS operating system.
Storage:	8.5 MB required to run the model.
Peripherals:	Minimum requirements: 1 printer, 1 Raster 380 graphics terminal, 1 VT100 terminal.
Language:	FORTRAN.
Documentation:	Documented with five published reports.

SECURITY CLASSIFICATION: Model is unclassified, but some data and model outputs are classified.

GENERAL DATA:

Data Base: 3 months to prepare digital terrain data base.

CPU time per Cycle: 31.72 seconds.

Data Output Analysis: Manual.

Frequency of Use: Used whenever required to support research and development efforts.

Users: U.S. Army Engineer Waterways Experiment Station.

Comments: Model has been activated on the AirLand Battlefield Environment Test-Bed System. Interest in the model has been expressed by personnel at TRAC-WS.

TITLE: Minotaur.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Studies, Concepts and Analysis Division, Logistics Directorate (J-4), The Joint Staff, The Pentagon, Room 2E827, Washington, DC 20318-4000.

POINT OF CONTACT: CDR K.J. Kelley, (703) 696-6110, AV 225-9212.

PURPOSE: Minotaur is an intertheater strategic deployment model and data management system. It is a research and evaluation tool that can be used to determine mobility force capabilities or requirements. Minotaur is intended for use in situations where a quick analysis of a problem using a highly aggregated and simplified representation of a deployment is sufficient.

DESCRIPTION:

Domain: Sea and air; limited land operations.

Span: Can accommodate global or any variety of intertheater movements.

Environment: Network-based air and sea movement.

Force Composition: Includes all unit and nonunit personnel and equipment required for deployment.

Scope of Conflict: Simulates only the deployment phase of a conflict. Presently used only for conventional wargaming and planning.

Mission Area: Intertheater mobility (airlift and sealift).

Level of Detail of Processes and Entities: Each unit to be moved is characterized by amounts of various equipment and supplies to be deployed, number of personnel, specific origin and destination, availability date reflecting readiness to deploy from the origin, and required delivery date at the destination. The transportation system assets may be mobilized at different times and rates. The aircraft and ships used for deployment are characterized by their speed, cargo-carrying capacity, and cargo-handling characteristics. Ships are individually described. Aircraft are tracked by type.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step and event-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Maximum values on key parameters, such as number of requirements (2975) result in a relatively first-cut analysis of intertheater deployment. Minotaur does not simulate port or airfield operations at either end of the deployment pipeline, nor does it simulate convoys or ships or attrition of aircraft and ships.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Input editor being enhanced.

INPUT: Uses six major input data files: scenario data, network data aircraft data, ship data, requirements data, and consumption rate data.

OUTPUT: Can produce output in report, tabular, and graph form. Report-generating routines allow the user to select a subset of movements generated by the model, sort them in any order, and generate tabular reports. Minotaur also provides an extensive set of screen graphics including pie charts, line charts, flat and three-dimensional bar charts, and stacked line and bar charts.

HARDWARE AND SOFTWARE:

Computer:	IBM PC or compatible with one hard disk drive and one floppy disk drive, a color/graphics display board, and an 8087 math coprocessor.
Storage:	640K memory.
Peripherals:	Monochrome or color monitor and printer.
Language:	Turbo Pascal Version 4.
Documentation:	User's Manual for the Minotaur System, October 1988, published by General Research Corporation.

SECURITY CLASSIFICATION: Unclassified (without data).

GENERAL DATA:

Data Base: Preparation of meaningful data bases can take several man-weeks and requires a significant level of technical and functional expertise.

CPU time per Cycle: Depends on data base size and scenario inputs. Small data bases can be processed in 5 to 10 minutes of CPU time.

Data Output Analysis: Immediate to two man-weeks (depending on complexity).

Frequency of Use: Infrequently used for logistic simulation.

Users: OSAD(PA&E), JDSSC, JCS (J-4).

Comments: Rarely used in J-4.

TITLE: MISCAT - Acronym related originally to Missile Scattering.

DATE IMPLEMENTED: 1989.

PROPONENT: Massachusetts Institute of Technology (MIT), Boston, MA.

WORK SPONSORED BY: CECOM Center for Night Vision and Electro-Optics, Attn: AMSEL-RD-NV-VMD-TST, Ft. Belvoir, VA 22060-5677.

POINT OF CONTACT: Thoai Nguyen, C2NVEO, DSN 354-4074, COMM (703) 664-4074.

PURPOSE: MISCAT model was originally developed under contract between Northrop, Inc. and Lincoln Laboratory, MA. Originally, the model was used in support of modeling missile scatterings. The model was altered by MIT to assist in the modeling of millimeter wave power returns from various background elements (e.g., trees, rocks, roads, and various vegetation). C2NVEO uses MISCAT and EMSARS models in support of its Multi-Sensor Synthetic Image Generation Program.

DESCRIPTION:
Domain: Background features (trees, grass, and soils).

Span: Accommodates several different MNW wavelengths (e.g., 35 GHz and 94 GHZ) for its predictions.

Environment: MISCAT executes on a Silicon Graphics Workstation.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Multi-Sensor 3-Dimensional Scene Generation.

Level of Detail of Processes and Entities: Feature File Construction. Precise composition and orientation of feature data is required to accurately model the ground surface area.

CONSTRUCTION:
Human Participation: Required for processes.

Time Processing: Batch.

Treatment of Randomness: MISCAT is basically a stochastic model.

Sidedness: N/A.

LIMITATIONS: Model has not been validated to completion.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Adding triple-bounce contribution, second-level shadowing, and rough-surface scattering.

INPUT: Feature Map; Dielectric coatings of features.

OUTPUT: Power return graph.

HARDWARE AND SOFTWARE:
Computer(OS): UNIX operating system, operating on Silicon graphics.
Storage: Hard disk required.
Peripherals: Laser printer.
Language: Believed to be FORTRAN 77, with C subprograms.
Documentation: Available from MIT.

SECURITY CLASSIFICATION: Unclassified, but restricted distribution to licensees for the source code of MISCAT.

GENERAL DATA:

Data Base: Extensive feature map required for accurate simulation of signal returns.

CPU time per Cycle: Depends on the size and complexity of the landscape.

Data output Analysis: None provided.

TITLE: MME - Mobilization Model.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Training and education.

PROPONENT: War Gaming and Simulation Center, Institute for National Strategic Studies, National Defense University (NDU-NSS-WGSC), Ft. McNair, Washington, DC 20319.

POINT OF CONTACT: R.D. Wright, (202) 475-1251, AV 335-1251.

PURPOSE: To help teach the structure of the military manpower system and to illustrate costs and wartime manpower yields of key peacetime, mobilization, and wartime personnel policies. Off-line discussions of qualitative, military judgement issues (force readiness, cohesion, equity, political feasibility) are an essential component of this model.

DESCRIPTION: The model implements any of a set of 40 policies and assumptions dealing with decisions in peacetime, mobilization, or wartime. Examples include the extent of female participation, the percent wartime manpower requirement authorized, and the level of recruiting effort in peacetime; time-phasing of Individual Ready Reserve or retiree call-ups at mobilization; choices about undermining CONUS units to provide fillers; or medical discharge standards in wartime. For enlisted members of all four services, the model calculates recruiting, retention, interservice competition, and force sizes and quality during a five-year peacetime planning horizon. After M-Day it calculates (in 10-day intervals) army combat and army support enlisted manpower supply, demand, and shortfalls. The deployment schedule for forces to fighting theaters and the casualty profile are fixed by the scenario. This exercise does not allow for prosecuting the war differently (although users can experiment with different casualty scaling factors).

Domain: N/A.

Span: Up to three theaters with wartime combat operations: CONUS nondeploying (strategic reserve), CONUS training base forces, and the rest of world.

Environment: N/A.

Force Composition: In peacetime: enlisted personnel for Navy, USMC, and Air Force; Army enlisted higher risk (e.g., combat arms) personnel; and Army enlisted lower risk (e.g., service support) personnel.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:
Human Participation: Policy specification and assessment of qualitative, judgmental factors.

Time Processing: Five-year peacetime calculations in quarterly time-steps. 180-day war in 10-day time-steps.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Limited treatment of officers and DOD civilians. No play of Coast Guard. Aggregation of Navy, Marine, and Air Force enlisted personnel into a single category masks wartime shortfalls in particular specialties.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Data base revisions, extended policy set, and improved screen input.

INPUT: Policy specification.

OUTPUT: Peacetime costs, recruiting success and force quality measures, and mobilization assets for four services. Wartime army enlisted supply and demand and shortfall profile. The model provides a list of flags, noting qualitative considerations involved with policies selected that require professional military judgment and evaluation.

HARDWARE AND SOFTWARE:

Computer:	A Z-248/IBM-AT or clone with 640K memory.
Storage:	Can run from a floppy disk.
Peripherals:	Printer.
Language:	N/A.
Documentation:	Manpower Mobilization Exercise and Model User's Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One week effort to specify an exercise scenario.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: Twice per year.

Users: NDU Industrial College of the Armed Forces and the Army War College.

Comments: Source code maintained at NDU-NSS-WGSC.

TITLE: MMFLY - Mathematic Missile Flight.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill High, ITT Avionics, (201) 284-2870.

PURPOSE: This program provides missile dynamic data, in three dimensions, for a given set of initial conditions.

DESCRIPTION: It is a mathematically modeled, 3-d generic missile flyout program, which may be used to model a range of missiles through appropriate input data.

INPUT: Missile velocity characteristic, navigation constants, G-limits and target/missile geometry.

OUTPUT: Missile/target dynamics data in the form of print/plot files.

HARDWARE AND SOFTWARE:
Computer: DEC VAX.
Storage: 100K Bytes; memory requirements: 2M Bytes.
Language: FORTRAN 77 (VAX).
Documentation: None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Typical data preparation is 5 minutes.

CPU time per Cycle: 30 seconds on VAX computer.

Usage: This program provides data for threat dynamic envelopes used by the INSSIM model.

Comments: This program has a multi-run mode of operation which allows flyout data (such as closest approach) to be generated for a 3-d grid of initial launch geometries.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: MOUSE - Model for Understanding Signal Environments.

DATE IMPLEMENTED: 1972.

MODEL TYPE: Analysis.

PROPONENT: Calspan Corporation.

POINT OF CONTACT: Gregory M. Lewandowski, 716-632-7500.

PURPOSE: The MOUSE model is a four-step analysis program that simulates an RF signal environment using Red, Blue and Grey equipment parameters and the locations of sites and equipments at those sites. It generates data that can be used in the design and/or analysis of receiver and signal processing equipment. It also generates pulse streams of data based on user constraints.

DESCRIPTION:
Domain: Air, land, sea, military, civilian.

Span: Accommodates any theater depending on the data base.

Environment: Models terrain statistically and takes site preparedness into consideration.

Force Composition: Can accommodate any force composition depending on the database. At present, it models emitters from 0° to 60° E. longitude and 45°-72° latitude.

Scope of Conflict: Radar RF emitters within any weapon category can be modeled depending on the data base.

Mission Area: All conventional and unconventional missions can be accommodated depending on the database.

Level of Detail of Processes and Entities: This model simulates the signal environment impinging on a receiver probe within an extensive laydown of emitters. Highly detailed receiver and transmitter antenna patterns are modeled. The pulse trains of each radar emitter (or effective noise in the case of CW) and additional statistical summaries are produced. Frequency, scan and pulse synchronization enter into the computations; special cases are also accommodated. Preferred antenna pointing directions, in azimuth, are based on deployment and employment considerations; in elevation, they are based on beam elevation angle and equipment physical and electronic characteristics. Preferred equipment usage is also considered in the data base. Probabilities of each equipment at each site type being "on" is included at input. Conditioning of emitters, that is, of one emitter being "on" or "off" as a result of another being "on" or "off" is also included. System wire length and internal electronic time delays are implemented. In addition, frequency separation for noninterference among systems at each site is considered. Receiver platform characteristics (location, altitude, heading, and climb, roll and yaw angles) are accounted for in the computations.

The MOUSE model is a detailed, pulse-to-pulse implementation of the radar range equation as the main process. Decisions, such as, the specific emitter at a site that play, are probabilistic based on doctrine and intelligence information.

CONSTRUCTION:

Human Participation: Required for case matrix determination, data input, and results evaluation. The model can be interrupted at the end of specific steps: equipment parameter setup, site location and emitter setup, signal environment generation, and results analysis.

Time Processing: The model generates a static snapshot of the signal environment, and has the capability of extrapolating and sorting pulse trains.

Treatment of Randomness: Probabilities are used in the selection of and determination of emitters and their condition of being "on" or "off". Distributions are used to select a number of emitter parameters, time delays, and pointing directions for TT and HF radars.

Sidedness: The MOUSE model simulates friendly, unfriendly and other radar emitters.

LIMITATIONS: Does not "fly" receiver through scenario.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Updated inputs as new information becomes available. Ability to "fly" aircraft through scenarios.

INPUT: Equipment characteristics, antenna patterns, equipment multi-beam frequency, scan and pulse synchronizations, operational probabilities and equipment beam "on/off" conditioning, site locations, type, equipment complement, time delay distributions, elevation angle distributions, receiver and platform characteristics, and output constraints.

OUTPUT: Emitter ID, location, range, signal amplitude, AOA and other operating characteristics. Number of emitters and combined pulse rate (or number of CN emitters and combined effective signal) at user-specified receiver thresholds in azimuth/elevation angle bins. Selected environments based on user constraint of azimuth and elevation angle, frequency, time, and receiver sensitivity. Also, pulse stream with overlapping pulses including individual signal parameters are produced.

HARDWARE AND SOFTWARE:

Computer: IBM 370 series, SUN.
Language: FORTRAN 77.
Documentation: Internal user's and engineering manual, and extensive in-code comments.

SECURITY CLASSIFICATION: Unclassified, but input data are often classified.

GENERAL DATA:

Data Base: Depends on extent of input data with two three months as being reasonable for data preparation.

Data Output Analysis: Because of extensive data analysis capabilities, analysis of final results can be accomplished within days or weeks depending on extent required.

Frequency of Use: Approximately 30-50 runs during an experiment.

Users: ASD, ESD.

TITLE: MPIRE - Methodology for Penetrator Route Evaluation.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: Calspan Corporation.

POINT OF CONTACT: Charles J. Mailhot (716) 631-6959; Gregory M. Lewandowski, (716) 632-7500.

PURPOSE: MPIRE is used primarily to evaluate the relative merit of effectiveness of penetration concept(s). MPIRE describes SAM and AI engagement opportunities as a result of EC system employment, tactics and mission planning. It is used to quickly conduct studies in many different areas to identify performance ranges and/or requirements for penetration aids.

DESCRIPTION:

Domain: Air, land, naval operations.

Span: This model accommodates regional scale situations Army Core, battalion and brigade level), the size of which depends on the mission and scenario support data. At present, the two main scenario areas have been Central Europe and Middle East. Longer strategic scenarios have also been used.

Environment: Local terrain masking and clutter effects are computed from DMA terrain elevation data.

Force Composition: MPIRE is a few-on-many model in that a penetrator with supporting assets (onboard/offboard jamming) and tactics flies against netted groundbased and airborne weapon systems.

Scope of Conflict: Conventional and nuclear Red, Blue, and Gray weapon systems.

Mission Area: Tactical and strategic air-to-ground missions.

Level of Detail of Processes and Entities: MPIRE requires input that describes the threat and penetrator scenario, and geographic environment. It is used for penetration concept evaluation with cause and effect trends that can be observed at the stage in which they become significant. Events in the model (aircraft movement, radar detections, etc.) are time-stepped along the penetrator flight path. Concepts, in general, have been focused on the characteristics of the penetrator, jamming assets, environment, and the threat. There are five major portions to the MPIRE methodology that: compute and describe the threat radar detection capability for each radar in the scenario against the penetrator including RCS and threshold reactive on/offboard jammers; compute local LOS to target based on DMA terrain elevation data, and clutter in both mainbeam and sidelobes; simulation of threat command and control structures to form track histories and weapon resource assignments (SAM C^2-system specific local and remove EW/ACQ and weapon launch with track radar and/or seeker lock-on; AI C^2 EW resources fused to represent Air Situation Center with AI assignments and intercept commitments); the fifth step is AI vectoring using platform aerodynamics and track data at the ACI/GCI supplemented by ASC track information (individual sensors and net can participate).

CONSTRUCTION:

Human Participation: Required for decisions and processes. A run is interruptable at majors steps.

Time Processing: Dynamic time-stepped.

Treatment of Randomness: The model is deterministic in that it generates values as a function of expected values.

Sidedness: MPIRE is a two-sided (Blue vs. Red or Gray), non-symmetric simulation.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Near-earth propagation loss.

INPUT: Radar parameters, site locations and equipment complement, RCS tables, jammer characteristics, flight path checkpoints, DMA terrain data, clutter maps, C^2 time delays, interceptor characteristics, detection thresholds, missile intercept envelope data, missile parameters and C^2 linkages.

OUTPUT: J/S ratio histories, return histories at sites, clutter and LOS histories at sites, track time histories and statistics, time history of target position, assignment state, ASC state, track radar state, AI position, SC and GCI/ACI modes, intercept time, launch opportunities and successful intercepts.

HARDWARE AND SOFTWARE:
Computer: IBM 370 series, VAX 11/780 with JMS, SUN.
Language: FORTRAN.

SECURITY CLASSIFICATION: Unclassified, but input data are often classified.

GENERAL DATA:
Frequency of Use: Continuous for past 12 years.

TITLE: MPRES - Method for Presenting Received Signals.

DATE IMPLEMENTED: Unknown.

MODEL TYPE: Analysis.

PROPONENT: USCINCPAC Staff (J55), Box 15, Camp H.M. Smith, HI 96861-5025.

POINT OF CONTACT: Mr. Ronald H. Uyehara, (808) 477-6467, AV (315) 477-6467.

PURPOSE: For a given air defense situation, MPRES is used to determine the times at which each target is detected or redetected by each radar, the times at which each target is lost by each radar because of fade or terrain masking, and the length of each radar track. The primary use of MPRES at USCINCPAC is to generate "detect/leave" events for the MABS-EX air defense model. It is also, however, used to determine radar detection ranges in the presence of noise jamming.

DESCRIPTION:

Domain: Air. MPRES models the airspace needed to simulate the coverage of a radar network. The geographical area that can be considered is limited only by the extent to which the earth's surface can be approximated by a rectangular coordinate system.

Span: Local and regional. Simulations with greater span are limited by the number of entities simulated and position errors caused by projecting spherical coordinates onto a planar surface.

Environment: Smooth earth with provisions for radar masking at 15-degree increments.

Force Composition: Aircraft flight paths and radar network types and locations.

Scope of Conflict: Conventional.

Mission Area: Air defense.

Level of Detail of Processes and Entities: Single aircraft flight paths and single radar coverage. Aircraft detection is modeled at the radar equation level with a step function detection threshold.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: ECM limited to noise jamming only.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Rehost to SUN 3/260 system.

INPUT: Aircraft flight path; aircraft radar cross section as a function of aspect in three dimensions; jammer power and antenna pattern as a function of aspect in three dimensions; radar antenna pattern in three dimensions; and radar vertical and horizontal beamwidths, PRF, receiver noise figure, and power.

OUTPUT: Coded printout with time on the abscissa and radars listed on the ordinate. For each flight path, the display shows the times at which the aircraft is detected by each radar and the times at which it is not detectable.

HARDWARE AND SOFTWARE:
Computer: Wang VS80B (OS 6.4); VAX 8650 (VMS 4.6.)
Storage: 5 MB.
Peripherals: Interactive terminal, printer.
Language: FORTRAN IV.
Documentation: User manual available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: 3 to 5 days.

CPU time per Cycle: 1 to 3 hours.

Data Output Analysis: Variable.

Frequency of Use: As needed.

Users: USCINCPAC; U.S. Forces Japan; Japan Self-Defense Forces.

Comments: None.

TITLE: MPS - Microcomputer Missile Performance Software.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAS), Pentagon, Rm 1D431 Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Knieriem DSN 225-9018 or Commercial (703) 695-9018.

PURPOSE: MPS is a research and evaluation tool to examine the utility and effectiveness of a limited ballistic missile attack over a range of scenarios. MPS also provides a net assessment of the effectiveness of the forces participating in the plan.

DESCRIPTION:
Domain: Land, air, space.

Span: Global.

Environment: Limited to continental land masses with national/state boundaries.

Force Composition: (Per case run) One ballistic missile type, 10 ballistic missiles, 25 reentry vehicles per ballistic missile, 250 target installations.

Scope of Conflict: Nuclear, red-on-blue, blue-on-red.

Mission Area: Land-based ballistic missiles (nuclear).

Level of Detail of Processes and Entities: Complete missile fly-out data for up to ten ballistic missiles. Considers range, target accessibility, footprint dimensions, flight effects, trajectory state vectors, fuel usage, and nuclear weapon effects.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Dynamic time- and event-stepped.

Treatment of Randomness: Deterministic and probabilistic.

Sidedness: One-sided.

LIMITATIONS: Limited in number of missiles/warheads per scenario and target base.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None, however expansion capability exists.

INPUT: Force structure, missile design parameters, and target base.

OUTPUT: Missile range, target accessibility, footprint dimensions, flight times, trajectory state vectors, post boost fuel usage, nuclear weapon effects, weapon assignment effectiveness and efficiency, scheduling results, damage achieved and standard measures of effectiveness (e.g., Damage Expectancy). Microcomputer graphics software available to produce maps and graphs of output information.

HARDWARE AND SOFTWARE:

Computer:	IBM-PC Compatible Systems.
Storage:	20 MB Hard Disk, 640KB RAM, Math Coprocessor.
Peripherals:	HP Laserjet and/or HP Paintjet Printer, MS-DOS.
Language:	Microsoft FORTRAN.

SECURITY CLASSIFICATION: Unclassified (without data base).

GENERAL DATA:

Data Base: 5-15 minutes.

CPU time per Cycle: 1-20 minutes per case.

Data Output Analysis: 1-10 minutes for graphics postprocessing.

Frequency of Use: Daily.

Users: AFSAA/SAS.

TITLE: MRM - Medical Regulating Model.

DATE IMPLEMENTED: September 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: MRM models land combat casualty and return to combat rates. It is designed to support logistics assessment in larger-scale war games.

DESCRIPTION:
Domain: Land.

Span: Theater.

Environment: N/A.

Force Composition: Theater-level ground forces.

Scope of Conflict: N/A.

Mission Area: Logistics.

Level of Detail of Processes and Entities: User defines combat force size, combat intensity, hospital locations and capacities, and casualty transportation distances. "Snapshots" of personnel status are provided as per user-specified times (days).

CONSTRUCTION:
Human Participation: Initial inputs and iterative time-step specification.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Stochastic, with Monte Carlo determination of results.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Hospital type (combat or communication zone), bed capacity and availability, geographic location, evacuation capability, casualty population, combat intensity, evacuation delays, and distances specified for each hospital. Casualty rates (killed and wounded as function of combat intensity, death due to wounds) are specified for each combat-intensity level. The disease and injury rate and the recover and return to duty rate are user-specified globally. User sequentially specifies time period (days) to be modeled.

OUTPUT: Status of all or any of the parameters input. If multi-day time-step selected, user may specify day-by-day output or end-of-period status only. Output may be sent to screen, printer, or written to data files.

HARDWARE AND SOFTWARE:
Computer: IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: N/A.

Language: FORTRAN 77.
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: 30 minutes.

CPU time per Cycle: 15 seconds.

Data Output Analysis: "Snapshot" of casualty numbers and locations.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: MRM is designed to provide theater-level land combat casualty accounting in support of larger-scale war games.

TITLE: MSEPAM - Mobile Subscriber Equipment Performance Analysis Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds,
ATTN: STEEP-(T-E), Ft. Huachuca, AZ 85613-7110.

POINT OF CONTACT: Mr. Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: The MSEPAM is an operational support tool used to provide a means for estimating the MSE system performance under various operational and environmental conditions.

DESCRIPTION:
Domain: Land only.

Span: Can accommodate any corps depending on data base.

Environment: Detailed, radio frequency, phenomenology model. Models effects of terrain and ground constraints in either an area predictions or point-to-point mode. User or Defense Mapping Agency-digitized terrain data as input.

Force Composition: Joint and combined, BLUE and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: MSEPAM is capable of modeling a range of complexity from a single radio transmitter to all the radios used by an entire army. Movement of MSE subscribers, background C-E emitters, turn-on/turn-off of EW, reliability-availability-maintainability (RAM) events and attrition are handled by the MSEPAM logic.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-step and event-step.

Treatment of Randomness: Can be run in either deterministic or probabilistic mode. Monte Carlo options are available for estimating propagation variations about the mean.

Sidedness: N/A.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Studies are underway to further reduce CPU time, to improve the user interface and to enhance MSEPAM's flexibility in addressing users' applications.

INPUT: Tactical deployment data, equipment technical performance characteristics, propagation path loss parameters, and MSE system-specific timing and performance data.

OUTPUT: Printout containing the signaling and timing delays and the message traffic through the system when the MSE is operating in its intended tactical operational environment.

HARDWARE AND SOFTWARE:

Computer:	CYBER 180 Model 830, Network Operating System Level 700.
Storage:	Variable, requirements can be adjusted. Currently using 376,500 words of central memory and 2.04 million words of extended memory adjusted according to deployment size.
Peripherals:	Optimum number of disk and tape drives varies, variable mass storage requirements, size of data files determines requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Minimum available, being prepared.

SECURITY CLASSIFICATION: Unclassified, but data bases are classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires one year. Analysis requiring data modification for specific changes requires one to two months depending on extent of changes.

CPU time per Cycle: Dependent on deployment size and equipment to be evaluated. CORPS size deployment can take 9.0/25.0 hours of CPU time per hour of simulation time for benign/EW analyses.

Data Output Analysis: Hardcopy printouts.

Frequency of Use: Currently being used for the first time.

Users: USAEPG.

Comments: The model is not machine dependent. However, it does take advantage of the CDC CYBER 60-bit word for optimization of data storage and access.

TITLE: MTTR - 3 Channel Monopulse Target Tracker.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze 3 channel monopulse radar responses to various ECM.

DESCRIPTION: The model was created using the Continuous Systems Modeling Program. It consists of a set of data records which describe the model as connected analog blocks (integrators, summers, gains, etc.). Some blocks are modeled directly with user supplied FORTRAN subroutines. The model simulates the target geometry, radar receiver antenna patterns, target echo and ecm signals, IF channels (including filters) and antenna az & el servos.

INPUT: CSMP ECM Model data with any user supplied FORTRAN ECM routines.

OUTPUT: Azimuth and Elevation tracking errors as well as printouts of any other individual block of the model.

HARDWARE AND SOFTWARE:
- Computer: DEC VAX series. Requires array processor.
- Storage: 150K Bytes; memory requirements: 1M Bytes.
- Language: VAX FORTRAN.
- Documentation: None.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is Secret.

GENERAL DATA:

Data Base: Typical data preparation is 2 days.

CPU time per Cycle: 5 minutes on VAX computer.

Comments: Status of Model - completed.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: MTTR2 - 2 Channel Monopulse Target Tracker.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze 2 channel monopulse radar responses to various ECM.

DESCRIPTION: The model was created using the Continuous Systems Modeling Program. It consists of a set of data records which describe the model as connected analog blocks (integrators, summers, gains, etc.). Some blocks are modeled directly with user supplied FORTRAN subroutines. The model simulates the target geometry, radar receiver antenna patterns, target echo and ecm signals, IF channels (including filters) and antenna az & el servos.

INPUT: CSMP ECM Model data with any user supplied FORTRAN ECM routines.

OUTPUT: Azimuth and elevation tracking errors as well as printouts of any other individual block of the model.

HARDWARE AND SOFTWARE:
- Computer: DEC VAX series. Should run on any machine which supports FORTRAN and Virtual Memory OS.
- Storage: 150K Bytes; memory requirement: 1M Bytes.
- Language: VAX FORTRAN.
- Documentation: Model block diagram.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
- Data Base: Typical data preparation is 2 days.
- CPU time per Cycle: 5 minutes on VAX computer.
- Comments: Status of Model - completed.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: MULTI-ASPIC - Multiple AWACS Simulation: Penetrator/Interceptor Combat Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis Organization, P.O. Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: Joetta C. Mark, (316) 526-2810.

PURPOSE: MULTI-ASPIC is used for the evaluation of engagements between penetrators and AIs directed by an AWACS. The model simulates the capabilities of AWACS airborne radar platforms as they direct fighters to intercept penetrating aircraft. Up to 10 surveillance and orbital areas may be defined. The simulation considers the following major interactions: AWACS and AI, AWACS and penetrator, and AI and penetrator. Specifically, it determines the possible times, angles, and coordinates at which an AWACS-directed interceptor detects and kills a penetrator that is under surveillance of the controlling AWACS.

DESCRIPTION:

Domain: Air (land in terms of aircraft basing only).

Span: The model is used in mission segment studies and analyses involving penetration through multiple AWACS surveillance areas.

Environment: Limited terrain features as they affect aircraft detection capabilities.

Force Composition: BLUE and RED air elements, including fighters, bombers, and AWACS.

Scope of Conflict: Conventional weapons include air-to-air missiles, guns, and ALCMs. No nuclear or chemical effects are considered.

Mission Area: Bomber Penetration through AWACS Surveillance.

Level of Detail of Processes and Entities: Movement is modeled for each individual player, including penetrators, ALCMs, AIs, and AWACS. MULTI-ASPIC is a many-on-many model with a one-on-one end game. Both AWACS to AI and AWACS to AWACS communication is modeled, but penetrating aircraft can be given the ability to jam any communications. The model simulates both electronic and deceptive countermeasures that can be used by the penetrators against both AI and AWACS platforms. Player attrition is determined by random draws against pK information when air-to-air missiles are launched or airborne guns are used.

CONSTRUCTION:

Human Participation: Required for input data base preparation and mission planning only. After execution begins, human participation is not normally allowed.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo determination of player attrition based on pK.

Sidedness: Two-sided, asymmetric, reactive model.

LIMITATIONS: Does not simulate missile flyout for air-to-air missiles. Penetrator weapons are considered only as generic bomber defensive weapons. AI autonomous activity is not allowed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Add calculations for missile flyout and provide for autonomous AI activity.

INPUT: Penetrator sorties, AWACS orbits, AI and AWACS base locations, weapon loading and launch parameters, basic flight parameters for all players, penetration aids and tactics, AWACS interceptor assignment and operational rules, AWACS and AI detection capabilities, and cruise missile launch points.

OUTPUT: Number of geometry for both AWACS and AI detections, engagement geometry at weapon release, player survival results, and time-ordered event trace.

HARDWARE AND SOFTWARE:

Computer:	APOLLO Workstations with a DOMAIN/IX operating system. (Previously executed on VAX 11/780 computer with VMS).
Storage:	750K bytes, including input files.
Peripherals:	None necessary. 1 printer if hardcopy is desired.
Language:	FORTRAN IV and FORTRAN 77.
Documentation:	Multiple AWACS Simulation: Penetrator/Interceptor Combat (MULTI-ASPIC) Model User/Analyst Manual--10/2/87.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Parametric Inputs - 2+ weeks. Tabular data may take several months to collect or generate.

CPU time per Cycle: Dependent on data base size and numbers of players. A typical scenario can take 3 or more hours.

Data Output Analysis: Postprocessors aid in condensing and analyzing output.

Frequency of Use: Varies by priority and requirements, but has been used for three or more studies in 1988.

Users: BMA, Operations Analysis.

Comments: Graphical data may be output and used as input to the Map Generation Model to describe penetrator routes and AWACS surveillance areas. The MULTI-ASPIC model is an upgraded version of the single AWACS ASPIC model which has been maintained and used since 1969 by the OA organization. In 1981 the model was modified to include ALQ-172 effectiveness for penetration analysis. Penetrator lethal defense was incorporated in 1986.

TITLE: MULTIWAR - Multiwarfare Scoping Model Version 2.0.

DATE IMPLEMENTED: 6 September 1988.

MODEL TYPE: Analysis.

PROPONENT: Space and Naval Warfare Systems Command (SPAWAR 301), Washington, DC 20361-5000.

POINT OF CONTACT: CDR John Casko, SPAWAR 31F1, (703) 692-4512; AV 222-4512.

PURPOSE: The MULTIWAR spreadsheet is a top-level, expected-value analysis tool designed to provide an overview of large-scale naval multiwarfare scenarios including ASW, AAW, and strike engagements. These specific areas are individually modeled, and are combined in a full-scale model of a wargaming scenario.

DESCRIPTION:

Domain: Undersea, sea, air, and land.

Span: Accommodates any theater depending on data inputs.

Environment: Environmental factors do not appear as direct inputs, although performance inputs for forces under environmental stress may be manipulated to reflect affected performance.

Force Composition: Combined forces, RED and BLUE.

Scope of Conflict: Primarily conventional, but nuclear weapons are possible.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: This model will handle forces from the platform level to the individual elements of ships, aircraft, submarines, or strike targets. Inputs associate all elements of the same type (all aircraft off a certain ship) with the same properties of detection, classification, targeting, and attack. Attrition, however, is at the aggregate level.

CONSTRUCTION:

Human Participation: Required for decisions and processes. The model contains specified breakpoints where the user has the option to direct the play or survey intermediate results.

Time Processing: Static; user has control of event sequencing and may direct according to a given scenario. Events always continue through completion once initiated.

Treatment of Randomness: Deterministic, expected value.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Does not model surface-to-surface naval engagement or mine warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: TBD.

INPUT: The spreadsheet requires the number and type of all elements for the RED and BLUE forces; weapons loadouts and effectiveness factors; movement probabilities such as detection, classification, and attack; countermeasure probabilities; and weapon distribution.

OUTPUT: Computer printouts, plots, and intermediate totals are available for the user through EXCEL standard features.

HARDWARE AND SOFTWARE:

Computer:	Apple Mac II or Mac Plus.
Storage:	Hard drive not required but operationally necessary for productive use of the model.
Peripherals:	Printer for results if desired. EXCEL Version 1.06 must be resident.
Language:	Microsoft EXCEL Version 1.06.
Documentation:	User's guide available. Analyst's Manual under development.

SECURITY CLASSIFICATION: Unclassified without data.

GENERAL DATA:

Data Base: Inputs for a new scenario could take man-months. Alterations to existing data bases could be performed much more quickly.

CPU Time per Cycle: Depends on data input and machine type; generally less than fifteen minutes.

Data Output Analysis: Analysis performed by operator using intermediate and final data from model calculations.

Frequency of Use: N/A.

Users: SPAWAR 31F architecture community including NOSC, NUSC, NSWC, and other Navy labs and contractors.

Comments: N/A.

TITLE: MUPPET - Multi-Purpose Performance Evaluation Tool.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.J. Ondrish, (301) 231-2097.

PURPOSE: The purpose of MUPPET is to display and provide an assessment or profile of the capability of AEGIS surface ship's combat system in the three warfare areas: AAW, ASU, and ASW.

DESCRIPTION:
Domain: Sea.

Span: Global.

Environment: Models existing state; portrays status.

Force Composition: One ship.

Scope of Conflict: Conventional.

Mission Area: AAW, ASU, and ASW.

Level of Detail of Processes and Entities: Uses Lotus 1,2,3 spreadsheet as an analytical framework to display the status of an AEGIS surface ship's combat system. Takes equipment status and produces computer displays such as graphs, bar charts, lists, and profiles in each warfare area. This model was developed as a research tool and a forerunner to other models and projects. It is now useful for demonstrations and for Producing graphical displays of a ship's effectiveness.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided/status display.

LIMITATIONS: Graphics and spreadsheet only.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None currently planned.

INPUT: All systems and equipment status.

OUTPUT: Graphics, as needed.

HARDWARE AND SOFTWARE:
Computer: IBM PC.
Storage: N/A.
Peripherals: Printer.
Language: Lotus 1,2,3.
Documentation: Notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: One minute or less.

Data Output Analysis: Hardcopy available.

Frequency of Use: Occasionally.

Users: Vitro Corporation (in-house).

Comments: MUPPET was developed as a research tool.

TITLE: MUVES - Modular UNIX*-based Vulnerability Estimation Suite.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Director, Ballistic Research Laboratory,
ATTN: SLCBR-VL-V, Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: Wendy A. Winner, DSN 298-5655, (301) 278-6655.

PURPOSE: The Modular UNIX-based Vulnerability Estimation Suite (MUVES) is the new software environment under which all vulnerability/lethality analyses conducted by the Vulnerability/Lethality Division of the Ballistic Research Laboratory will be performed. Currently, the compartment-level vulnerability/lethality model, Vulnerability Analysis Methodology Program (VAMP), is implemented under this environment. The stochastic point-burst model, SQuASH (Stochastic Quantitative Analysis of System Hierarchies), will be implemented shortly. Vulnerability/lethality analysis of armored combat systems consists of assessing and evaluating the effects of a threat (e.g., a kinetic-energy round, a shaped-charge munition, etc.) against a combat system.

DESCRIPTION:
Domain: N/A.

Span: N/A.

Environment: N/A.

Force Composition: Conventional munition impacting one combat system.

Scope of Conflict: Conventional.

Mission Area: N/A.

Level of Detail of Processes and Entities: Vulnerability/lethality analyses are performed for one threat; e.g., a kinetic-energy round, impacting one combat system. Compartment-level vulnerability/lethality analyses commonly evaluate the combat system's firepower loss-of-function, mobility loss-of-function, and the probability of catastrophic kill.

CONSTRUCTION:
Human Participation: Human participation is not required, and the model is not interruptable. A user-friendly, menu-driven interface is provided to assist users with setting up model inputs, setting up analysis runs, and postprocessing model outputs.

Time Processing: Static.

Treatment of Randomness: Model computation for the compartment-level vulnerability/lethality model are deterministic. Model computations for the stochastic point-burst model shall be a Monte Carlo simulation.

Sidedness: N/A.

LIMITATIONS: Interaction and evaluation software modules for Explosively Formed Penetrators (EFPs), Fly-over & Shoot Down munitions, and certain special armor packages are needed to perform certain compartment-level vulnerability analyses. A substantial amount of time is required to build the geometric target descriptions required to perform compartment-level vulnerability analyses.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The stochastic point-burst vulnerability/lethality model will be implemented. Cited compartment-level model limitations for interaction & evaluation modules will also be addressed.

INPUT: The basic types of files required to perform a compartment-level vulnerability analysis include: 1) threat parameters describing the characteristics of the threat capable of damaging the target, 2) target parameters and target ray-tracing inputs, and 3) interaction and evaluation "curves" for modeling and evaluating the target-threat interaction.

OUTPUT: For each analysis run, MUVES produces a final results file which contains the remaining functionalities; e.g., firepower loss-of-function, for each shot analyzed during the run. At user request, an intermediate results file containing the various internal values; e.g., residual penetration, used during the internal analysis computations may be output. Postprocessed outputs from the MUVES final results file are often the most useful. Postprocessed outputs include: 1) weighted averages of the target's loss-of-functions/probabilities, 2) color-shaded cell plots, and 3) cell-by-cell loss-of-function/probabilities.

HARDWARE AND SOFTWARE:

Computer(OS): MUVES is designed to run on System V compatible UNIX platforms. MUVES has been compiled and tested on the following platforms: Silicon Graphics 4D family IRIX 3.3.2, Alliant CONCENTRIX 3.0, Gould/Encore UTX/32 2.0 (with System V emulation), and Cray X-MP UNICOS 5.1.

Storage: To install MUVES source code minimally requires 10 Mbytes. The disk space requirements for model inputs and outputs varies. For an analysis of several threats versus one armored combat system, 200 Mbytes is recommended. MUVES software only requires two software libraries from Ballistic Research Laboratory Computer-Aided Design (BRL-CAD) software package. MUVES currently only ray-traces target descriptions built with BRL-CAD's Multi-device Graphics Editor (MGED). To install BRL-CAD source code with full functionality requires approximately 200 Mbytes.

Peripherals: Minimum requirements: 1 Graphics workstation, 1 printer, and 1 color-printer.

Language: ANSI C compliant.

Documentation: A MUVES software installation guide and a MUVES Analyst Guide (over 180-pages) is available. The MUVES Analyst Guide references numerous other vulnerability/lethality publications.

SECURITY CLASSIFICATION: Unclassified. Model inputs and outputs are often classified.

GENERAL DATA:

Data Base: MUVES inputs for a compartment-level analysis of one combat system and one threat typically requires a quarter of a man-year.

CPU time per Cycle: Execution time is dependent upon the combination of target, threat, and the analysis selections. Execution time varies by machine architecture. Typical compartment-level analysis of one combat system and one threat at 12 different views (azimuths/elevations) normally requires under an hour of CPU execution time.

Data Output Analysis: Postprocessors aid in analyzing final and intermediate MUVES output files.

Frequency of Use: The MUVES implementation of this compartment level model will be used for several Ballistic Research Laboratory studies this year. Use of MUVES is expected to increase as more BRL personnel are trained to use this software package.

Users: Ballistic Research Laboratory (BRL) and U.S. Army Missile Command.

Comments: UNIX® and System V® are registered trademarks of AT&T.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: NACM - NADC ASW Campaign Model.

DATE IMPLEMENTED: Under development.

MODEL TYPE: Analysis.

PROPONENT: AI Branch (7013), Software Technologies Application Division (701), Systems and Software Department (70), Naval Air Development Center (NADC), Warminster, PA 18974-5000.

POINT OF CONTACT: Christof H. Heithecker, AV 441-3731, Comm (215) 441-3731.

PURPOSE: NACM is designed to be both a Research & Evaluation Tool and an Operation Support Tool (Decision Aid). At the campaign level, NACM provides a comprehensive model of Fleet ASW operations and asset performance against subsurface threats. NACM provides theater-wide estimates of Red submarines detected, trailed, and killed by Blue search assets performing cued and uncued search during simulated campaigns. NACM is designed to be integrated with the Capabilities Assessment and Evaluation System (CASES).

DESCRIPTION:
Domain: Air (VP) and subsurface (SSN) ASW operations.

Span: Accommodates any theater depending on data base; current implementation is for Pacific theater.

Environment: Acoustic environment and performance prediction modeled via access to OPTAMAS (Parabolic Equation (PE) Model and CZ-Astral) and Raymode. OPTAMAS supplies probability of detect coverage maps for IUSS sensors and signal excess (SE) values for target-sensor geometries used in Search Probability Area (SPA) computations. Raymode supplies SEs and Minimum Detection Range (MDR) for SSN towed-array and VP sonobuoys.

Force Composition: Blue ASW Assets (SSN and VP, IUSS sensors) against Red SSNs.

Scope of Conflict: Conventional warfare as performed by Blue ASW assets against Red threats. Model covers Pre and Post D-Day operations. After D-Day, Blue Assets launch weapons against Red SSNs (e.g., torpedoes, Harpoons). Red has ability to fire back.

Mission Area: Wide Area ASW operations for sea control/denial and Battle Group support.

Level of Detail of Processes and Entities: Entities (objects) modeled at the lowest level include Blue IUSS sensors (fixed arrays and TAGOS), Blue VP and Blue SSN, and Red SSNs. Blue Command and Control nodes and processes are also modeled. Nodes include ASW Command Authority, IUSS Command, ASWOCs, and Submarine Operating Authority (SUBOPAUTH). Processes include the generation of IUSS SPAs and their dissemination to ASWOCs and SUBOPAUTH; transmittal of this cueing information to SSNs and VPs; SSNs and VP aircraft assigned to operations areas and engaging in cued and uncued search; detection, localization, trail, and kill of Red SSNs.

CONSTRUCTION:
Human Participation: Once model has been parameterized (e.g., order of battle established, Blue force operations and Red target behavior specified) human intervention is not required. Model is interruptable for limited editing of parameters (e.g., removal or delay of assets assigned to problem).

Time Processing: Dynamic, time- and event-stepped model.

Treatment of Randomness: SPA generation relies on stochastic lambda-sigma process. Submarine patrol logic is random-walk. Localization, trail, and kill outcomes are based on dice rolls against designated probabilities. Other processes are deterministic simulation. External calling program (e.g., CASES) can set up multiple Monte Carlo replications which will determine output statistics.

Sidedness: Two-sided in that Red can shoot back at Blue but only if shot at first.

LIMITATIONS: Currently operational for Pacific data only. Blue and Red operations are not symmetric (e.g., a Red C^3 structure is not in place). Some Blue C^3 operations (e.g., hand-off and turnover) are also lacking or limited in fidelity. As model is still under development, continued evolution and enhancement will take place in the future.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Limitations cited above will be relaxed. Atlantic data for OPTAMAS will be supplied. ASW operations as carried out by COMDESGRU and other surface ships will be included. Modeling of Diesel prosecutions and Third World operations is proposed.

INPUT: Blue ASW asset and Red submarine order of battle; setup of Blue ASW operations areas and arrival times on station; time-phased deployment of Red submarines; selected performance criteria of Blue ASW sensors and weapons.

OUTPUT: For each day of the simulated campaign, a summary of Blue cost (VP and SSN deployed, sorties flown, weapons and sonobuoys expended) vs. Blue return (cued and uncued engagements with Red targets - detections, localizations, trail duration, targets killed). Also daily state information for each participant in the campaign (e.g., location and status of all simulation objects).

HARDWARE AND SOFTWARE:

Computer:	Runs on SUN series computers under UNIX operating system.
Storage:	Requires on the order of 10 megabytes executable (not including OPTAMAS or other external CASES requirements).
Peripherals:	Nothing needed outside of regular CASES run time configuration.
Language:	C, with a tracker (for SPA ellipse construction) in FORTRAN.
Documentation:	Extensive working memoranda - more formal documentation set to be delivered as model becomes part of next CASES release.

SECURITY CLASSIFICATION: Model is unclassified but data bases may be classified. OPTAMAS IUSS data is classified Secret.

GENERAL DATA:

Data Base: Supporting OPTAMAS data base either precomputed or computable via PE model on Supercard (can take over an hour to compute transmission loss data for higher frequencies). Model data supplied from external file or CASES--model setup should take on order of an hour.

CPU time per Cycle: Dependent on number of participants in simulation. A campaign for 10 days encompassing on the order of 15 players takes no more than 10 seconds CPU time to run (assuming all OPTAMAS data has been precomputed).

Data Output Analysis: Data output in tabular form either stand-alone or via CASES. A CASES postprocessor (ASSESS) aids in analysis of results.

Frequency of Use: Not yet in operational use.

Users: Projected to be all users of CASES models.

Comments: Supersedes Area, Barrier, and Transitor Prosecution functionality in previous CASES releases.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: NADM - NORAD Air Defense Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: NORAD HQ/J5Y, NORAD Plans Analysis, Building 1470, Peterson AFB, CO 80914.

POINT OF CONTACT: Ms. Kathie Reece, AV 692-3781, Comm (719) 544-3781.

PURPOSE: NADM is used primarily to analyze force structures and capabilities for NORAD HQ and NORAD ROCCs. It is designed to assess the value of different mixes of forces or resources. It is used to determine first order effects of changes in performance, effectiveness, deployment and employment of existing and proposed air defense systems.

DESCRIPTION:
Domain: A discrete global air defense model that includes land, space, air and sea.

Span: Can accommodate any area. North America data base is complete.

Environment: Smooth, spherical earth assumed (e.g., no terrain), perfect weather. Input time of day, year and month for analysis of Over-the-Horizon Backscatter radar performance.

Force Composition: NORAD forces including fighters, AWACS, and radar systems (OTHB, SBR, aerostats, ground based).

Scope of Conflict: Air breathing threat against North America, includes bombers, cruise missile carriers and cruise missiles.

Mission Area: Integrated Tactical Warning and Attack Assessment, Damage Limitation.

Detail of Level of Processes and Entities: The defensive forces include ground based radars, OTHB, SBR, AWACS, fighter aircraft and area weapons. The model simulates the interaction of attacking bombers and air-breathing missiles and the defensive forces to determine the outcome of resulting engagements. Five principal functions are modelled: a) Movement of the attacking force over penetration routes in raids as designed by planners; b) Detection of the raids at the intersection of their route with the radar coverage pattern; c) Commitment of the number of fighters required by tactical defense doctrine to neutralize each raid, from bases which afford the earliest possible intercept times following detection; d) Engagement action in which results are determined probabilistically to establish either bomber kills or survivors; e) Manned interceptor recovery and turnaround at the nearest appropriate base in preparation for subsequent commitment. Individual aircraft and missiles.

CONSTRUCTION:
Human Participation: Model is uninterruptable. Participation for model inputs is required.

Time Processing: Dynamic, time- and event-stepped model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two sided, Red is non-reactive. Blue is reactive to Red.

LIMITATIONS: Ground damage is ignored. Command and control is assumed to exist wherever surveillance coverage exists. Gross errors, excessive delays and communication outages cannot be simulated. ECM is simulated only to the extent that it affects the detection delays and intercept probabilities. Passive tracking, masking penetrators, inaccurate raid counts are not considered.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Graphics is to be added to the model so that the simulation can be visually seen. Red and Blue planner (graphics) will also be developed. Prototypes are already in use.

INPUT: Radar locations and performance parameters, AWAC routes and radar parameters, interceptor locations and fighter characteristics, threat scenario.

OUTPUT: Chronological report of simulation, attrition reports, interceptor activity.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on SUN computer with UNIX. Currently running on SUN 4/360CXP. Nongraphics simulation will run on any platform with the appropriate compiler.
Storage:	2 to 3 MBytes.
Peripherals:	Line printer, Graphics version requires a color printer.
Language:	SIMSCRIPT II.5, Graphics version also uses "C" and the SUNVIEW environment.
Documentation:	In progress.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of data base is simple, large scenarios can be developed in less than 2 weeks, simple scenarios in a day.

CPU time per Cycle: Dependent on data base size. Large scenarios can take less than 5 minutes on SUN 4/360.

Data Output Analysis: For each specific question that the simulation answers, output reports are programmed directly in. Output is well summarized.

Frequency of Use: Used on a routine basis.

Users: NORAD and many contractors who support NORAD. The model was the basis for STRATDEFENDER and is widely used.

Comments: N/A.

TITLE: NAM - Network Assessment Model.

DATE IMPLEMENTED: 25 June 1986.

MODEL TYPE: Analysis and education.

PROPONENT: U.S. Army Signal School, Fort Gordon, GA 30905.

POINT OF CONTACT: CPT Anthony Tabler, (404) 791-3782, AV 780-3782 or Mr. Jim Malcom, Teledyne Brown Engineering Project Manager, (205) 726-2781.

PURPOSE: As an analysis tool, NAM deals with force communications effectiveness and combat development doctrine evaluation. As a training and education tool, NAM develops the skills of the C3I planners in general, and the skills of the communications planner in detail.

DESCRIPTION:

Domain: Air and land.

Span: Army brigade to theater.

Environment: Uses terrain elevation data for communications propagation and displays cultural features for analytical uses.

Force Composition: Army, joint or combined.

Scope of Conflict: Electronic warfare only. Effects of attrition from other effects may be entered against the force or the communications model.

Mission Area: C3I.

Level of Detail of Processes and Entities: Several levels of detail possible. The fundamental entities are BLUE OPFACs, BLUE communications OPFACs, and RED EW OPFACs. OPFACs can be defined at any level from team to major theater command centers. OPFACs may be aggregated into super OPFACs if needed. Force effectiveness modeled as a function of communications performance. This performance is based upon four stress factors: battlefield activity including movement, threat activities including EW and attrition, physical properties including electromagnetic propagation, and force traffic.

CONSTRUCTION:

Human Participation: Required for graphical processes for scenario construction; not required, however, during run. The output viewing processes are also highly interactive.

Time Processing: Event-step with a clock interval of 10 milliseconds.

Treatment of Randomness: Traffic modeling is stochastic. Other stress factors are deterministic.

Sidedness: One-sided.

LIMITATIONS: The models limitations are as follows:

	Current	Future
OPFACs	1000	8000
MSE Nodes	100	100
TRITAC Nodes	50	50
Extensions	200	250
Radio nets	100	100
Radios/net	30	30
JTIDS nets	10	10
EPLRS nets	8	8
EPLRS comm	1	5
Jammers	100	100
Map size	5x8	5x8

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of packet switch scattering, frequency management tools, and tropospheric scattering model. A fifth stress factor is anticipated.

INPUT: Force list, CDB, and program of battlefield activity using interactive graphics.

OUTPUT: Playback of scenario over tactical situation; playback of network actions including traffic; and statistical analysis function for stress impacts by OPFAC, network, battlefield functional area, and architecture.

HARDWARE AND SOFTWARE:

Computer: Silicon Graphics 3100 series workstations w/UNIX OS. Porting in progress for Silicon Graphics 4D series workstations. Nongraphic processes (actual simulation run modules) portable to almost all UNIX-based machines with K&R "C" Compiler. No current graphics process portability.

Storage: 100 MB.

Peripherals: None required; printer and graphics screen printer recommended.

Language: "C" (K & R standard).

Documentation: Functional description, users manual, and programmers maintenance manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Army OPFAC data base and Army CDB are used to drive the model.

CPU time per Cycle: Unknown at this time.

Data Output Analysis: Unknown at this time.

Frequency of Use: N/A.

Users: U.S. Army Signal School and Tactical Missile Defense Program.

Comments: Twelve hours of simulation requires two weeks of preparation, eight hours of run time (variable).

TITLE: NAVMOD - Naval Model.

DATE IMPLEMENTED: March 1983.

MODEL TYPE: Analysis.

PROPONENT: The Joint Staff, Force Structure, Resource, and Assessment Directorate (J-8), Conventional Force Analysis Division (CFAD), The Pentagon, Washington, DC 20318-8000.

POINT OF CONTACT: Naval Analysis Branch, CFAD, (703) 695-9145.

PURPOSE: NAVMOD is a theater-level model designed to evaluate the combat outcomes of naval force interactions used for various Joint Staff assessments.

DESCRIPTION:

Domain: Air and sea, as related to naval forces. Geographical considerations of opposing forces are not considered explicitly but maybe included implicitly by adjusting combat factors as the geography alters the capability of weapons platforms.

Span: Theater or regional.

Environment: Parameters must be adjusted to reflect specific environments; accordingly, the model can adapt to any environment.

Force Composition: The BLUE forces can consist of aircraft carriers, escort ships, other surface ships, submarines sea-based attack and fighter aircraft, sea-based land-attack cruise missiles, and land-based naval aircraft. The RED forces can consist of surface ships (and associated aircraft), submarines, land-based attack and defensive aircraft, and ground defense.

Scope of Conflict: Conventional.

Mission Area: All conventional naval engagement, except mine warfare.

Level of Detail of Processes and Entities: Numbers of types of aircraft, ships, and submarines that can be input is adequate for present force structures. The model aggregates platform performance parameters into one generic capability, as instructed by the analyst.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time- and event-stepped model. Progresses through events at a user-specified ratio of model time to real time.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Command, control, communication, intelligence, electronic warfare, and mine warfare are not explicitly modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A

INPUT: Requires that the orders of battle for both sides and the factors describing the combat capabilities of all force be entered. Geographical considerations of the opposing forces are not considered but may be included implicitly by adjusting the combat factors as the geography alters the capability of the weapons platforms. The model includes a single preprocessor to facilitate inputs.

OUTPUT: Reports on the status of forces after each combat interaction (i.e., submarine versus submarine, surface force versus air, etc.). These reports give the expected value of the number of platforms remaining at full strength.

A summary report that gives the expected results after each time period is included.

HARDWARE AND SOFTWARE:
- Computer: VAX with VMS operating system.
- Storage: 100,000 blocks preferred; includes room for data.
- Peripherals: 1 printer, 1 VT-100 terminal.
- Language: FORTRAN IV, INGRES.
- Documentation: Extensive manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of large data bases can take several man-years.

CPU time per Cycle: 45 to 90 seconds.

Data Output Analysis: N/A.

Frequency of Use: Approximately 20 times a year.

Users: CFAD/J-8, IDA.

Comments: A mature naval model that requires operator familiarity to be most effective.

TITLE: NAWSIM - Naval Warfare Simulation.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: Maj. Ed Poniatowski, (49) 631-536-6507, DSN 489-6507.

PURPOSE: NAWSIM Models sea warfare including ship movement, surface, subsurface, and air warfare.

DESCRIPTION:
Domain: Air, land and sea.

Span: Theater.

Environment: Latitude- and longitude-based. Models day and night operations and limited weather.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional.

Mission Area: Sea control.

Level of Detail of Processes and Entities: Individual ships, aircraft or Task Forces.

CONSTRUCTION:
Human Participation: Required for decisions and tasking. Continues to run without a decision or tasking.

Time Processing: Dynamic, time-step. Uses a ratio of user specified exercise time to real time.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided, asymmetric, both sides interactive.

LIMITATIONS: Limited air-to-air and air-to-ground.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved graphics capability.

HARDWARE AND SOFTWARE:

Computer:	VAX with VMS operating system.
Storage:	One MB.
Peripherals:	Minimum requirements: 4 VT100-type terminals. Can also drive SUN and VAX 2000 workstations.
Language:	RATFOR, FORTRAN, and "C".

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Frequency of Use: 2-3 times per year.

Users: WPC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: NEST - Naval Exercise Support Tool.

DATE IMPLEMENTED: 20 February 1989.

MODEL TYPE: Training and education (with limited analytical capability).

PROPONENT: Naval Space Command, Dahlgren, VA 22448-5170.

POINT OF CONTACT: Maj. M.J. Kramer, 703-663-2677, AV 249-7876.

PURPOSE: NEST models the interactions between satellites and objects on or near the surface of the earth. This modeling allows rapid modeling of the architecture and effectiveness of space-based radar, etc., and an assessment of the systems effectiveness in terms of percent coverage, satellite sensor dwell times, gap times, and ratios. As a training and education tool, NEST develops the skills of individuals. As an operations support tool, it aids in decision making.

DESCRIPTION:

Domain: Space, earth surface, and near-earth surface.

Span: Global, with the ability to focus on areas smaller than a theater.

Environment: Topographic features and average sea depth extracted from the World Data Base II map system can be displayed but are not considered in the movement of tracks or the propagation of emissions.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: NEST does not model conflict or weapons systems.

Mission Area: The analysis from NEST is primarily used for sea control and strike planning. It can be used with any warfare area in planning for satellite coverage or satellite avoidance.

Level of Detail of Processes and Entities: The lowest entity modeled is the individual ship, aircraft, or radar against the individual satellite. The analysis of the interaction between satellites and objects on or near the surface of the earth considers communications between satellites and ground sites as well as the movement of the satellites and the near-earth surface objects.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step, where the size of the time-step can be defined by the operation.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: NEST assumes linear propagation of radio waves (no refraction or reflection), and assumes a smooth earth (no topography).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Satellite models, satellite ephemeris data, near-earth surface objects emitter characteristics, locations, courses, and speeds.

OUTPUT: Computer printouts or plotter printouts and statistical summaries.

HARDWARE AND SOFTWARE:

- Computer: Hewlett Packard model 9020.
- Storage: Minimum storage 15 MB or hard disk memory space.
- Peripherals: A graphics plotter, a graphics printer, a digitizer pad, serial outputs, and an RGB output.
- Language: Rocky Mountain BASIC.
- Documentation: Very limited; classified. Contact the point of contact for details.

SECURITY CLASSIFICATION: Unclassified, but data bases are at least secret.

GENERAL DATA:

Data Base: Initial data bases are provided with the model. The time required to modify and update them depends upon the level of complexity of the problem, but averages less than one hour.

CPU time per Cycle: Depends upon the level of complexity of the problem, but averages less than one hour.

Data Output Analysis: Produces hardcopies of satellite pass times.

Frequency of Use: Varies by command.

Users: JEWC, Naval War college, Naval Post Graduate School, CINCSPACE, Naval Space Command, and Carrier Air Groups.

Comments: NEST linked to Prototype Ocean Surveillance Terminal (POST) and Prototype Analysts' Work Station (PAWS).

TITLE: NETS - Netted EW/GCI Tracking System Model.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: Operations Analysis Staff, Boeing Military Airplanes, Wichita, KS.

POINT OF CONTACT: Mr. D. Moore (316) 526-3021.

PURPOSE: The Netted Early Warning Ground Control Interceptor Radar Tracking System Model is a simulation computer program written in FORTRAN and designed to evaluate the ability of an air defense complex (such as a logically communications netted EW/GCI ground radar system) to vector airborne interceptors to the vicinity of a penetrating aircraft.

DESCRIPTION:

Domain: Land and air. Can simulate shipborne air defense radar vectoring of AIs.

Span: Accommodates any EW/GCI radar threat beddown or subset thereof; primarily used to simulate Soviet EW/GCI radar network.

Environment: Terrain masking of each radar site is sensitive to penetrator aircraft altitude, radar antenna height, and individual site terrain characteristics (flat, rolling, or hilly).

Force Composition: One penetrating aircraft, one assigned AI, network of EW/GCI radars.

Scope of Conflict: No weapons or pKs in the simulation.

Mission Area: Strategic missions with fixed penetrator flight paths.

Level of Detail of Processes and Entities: A Monte Carlo simulation technique is used to fly a penetrator aircraft in three dimensions over a netted system of ground radar sites. The EW/GCI ground radar detection and tracking capability is simulated using probability distributions and functions to determine when AIs can be assigned and to make penetrator heading, speed, and position estimates to direct an AI to the penetrator thus simulating the manual tracking of a radar operator using a PPI scope.

The NETS model simulates one penetrating aircraft at a time, flying a predetermined path over a group of EW/GCI radar sites. AI combat air patrols are located throughout the geographic area, and AIs of various types are available at these locations to be selected for assignment to intercept the penetrating aircraft. Airborne jammer aircraft may be in the vicinity to degrade the ability of the EW/GCI to detect and establish a radar track on the penetrating aircraft. Communications jamming by penetrator can be simulated.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic, time-step, event-dependent processing path.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Number of penetrator flight path lets, number of EW/GCI radar sites, number of radar types, number of AI combat air patrol locations, number of AI type, and number of airborne jammers are limited only by current dimension statements in the FORTRAN code.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None currently planned.

INPUT: Penetrator: speed, altitude, radar cross section, and flight path turnpoints. EW/GCI: radar characteristics and locations, netting, and communication delays. AI: characteristics, locations, and vectoring doctrine. Jammer aircraft: locations and characteristics.

OUTPUT: Probability of AI encounter, AI encounter times, number of AI encounters by sector, penetrator time in EW/GCI radar coverage, and ground radar threat density by type.

HARDWARE AND SOFTWARE:

Computer:	APOLLO.
Storage:	Data base dependent.
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	Boeing Document No. D500-11432-1 Model 13 August 87 (proprietary).

SECURITY CLASSIFICATION: Unclassified code.

GENERAL DATA:

Data Base: Time required to prepare a data base can vary from several hours to several weeks depending on size.

CPU Time per Cycle: Penetrator flight path and data base dependent, typically less than five minutes.

Data Output Analysis: Statistical postprocessors to analyze both AI encounters and EW/GCI radar coverage history.

Frequency of Use: Several times per year.

Users: Boeing Operations Analysis Staff.

Comments: The model can be used for stand-alone analysis or as a generator of AI encounter events for a larger scale campaign model. The NETS model has been verified and validated.

TITLE: NMSTPA - Naval Minesweeping Tactical Planning Aid.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: USCINCPAC Staff (J55), Box 15, Camp H.M. Smith, HI 96861-5025.

POINT OF CONTACT: Mr. M.L. McCurdy, (808) 477-0797, AV (315) 477-0797.

PURPOSE: NMSTPA is a decision aid used for optimizing naval minesweeping tactics. It assists the user in identifying tactics that provide favorable combinations of attrition and effort. The model uses three MOEs: minefield clearance level, expected minesweeper casualties, and direct effort (in minesweeper-hours). During each model cycle, the user solves one of three planning problems, in which tactics are selected to optimize one MOE subject to constraints on the other two. NMSTPA can be used iteratively to analyze sensitivities to any of its inputs or to trade off two MOEs.

DESCRIPTION:

Domain: Sea.

Span: Local.

Environment: Users consider environment implicitly through the values they assign to model inputs.

Force Composition: Naval mines and minesweepers only. Mines are assumed to be of a single type and setting, with the exception of ship count setting. All minesweepers have identical minesweeping characteristics.

Scope of Conflict: Conventional.

Mission Area: Sea control (naval mine warfare).

Level of Detail of Processes and Entities: Individual minesweepers and mines are not explicitly represented. Minesweepers are continuous rather than discrete entities. Mines are represented by a uniform distribution of mine locations through which minesweepers must pass. Attrition is bilateral: minesweepers clear mines and mines cause minesweeper casualties. Both types of attrition are functions of minesweeper tactics, which also determine the amount of effort expended in sweeping a minefield.

CONSTRUCTION:

Human Participation: Required. NMSTPA requires interactive input of data specifying the problem to be solved. However, once a problem is specified, the program may not be interrupted. When calculations for a problem are complete, NMSTPA prompts the user for data specifying a new problem.

Time Processing: Dynamic, closed form. However, results are not presented as time-dependent.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Limitations include consideration of single minesweeper and mine types and a limited variety of ship count distribution for mines. Model is also limited to considering sweeping tactics characterized by fixed track spacing and number of runs per track. Other limitations are discussed in the documentation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Data describing minefield characteristics, minesweeper characteristics, minesweeper-mine interactions (actuation and damage data), and problem specification (including values of constrained MOEs).

OUTPUT: Screen displays and optional printouts.

HARDWARE AND SOFTWARE:

Computer:	VAX (VAX/VMS) or IBM-compatible PC (MS-DOS).
Storage:	84 Kbytes (VAX).
Peripherals:	Interactive terminal, optional printer.
Language:	ANSI Standard FORTRAN 77; Code substantially conforms with COMINEWARCOM FORTRAN Programming Standard.
Documentation:	USCINCPAC Technical Report, A Cognitive Planning Aid for Naval Minesweeping Operations, 25 April 1987 (Revised April 1988). The software includes online help utilities, a tutorial, sample problems, and user notes.

SECURITY CLASSIFICATION: Unclassified. However, COMINEWARCOM considers this software developmental, and the proponent may not honor all requests for release.

GENERAL DATA:

Data Base: 1-2 minutes.

CPU time per Cycle: Minutes on the VAX; hours on the IBM-compatible PC.

Data Output Analysis: Seconds.

Frequency of Use: 4-5 times per year.

Users: USCINCPAC, USCINCPACFLT, U.S. Naval Coastal Systems Laboratory.

Comments: None.

TITLE: NRMM - NATO Reference Mobility Model.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis (primarily a vehicle mobility evaluation model).

PROPONENT: NRMM Technical Management Committee.

POINT OF CONTACT: Mr. Peter Haley, (313) 574-8633; Mr. Donald Randolph, (601) 634-2694.

PURPOSE: NRMM predicts and compares mobility capabilities of candidate ground vehicles for operation in selected areas of the world. It evaluates mobility capabilities in the military ground vehicle acquisition process. NRMM can also be used in course of action assessment, vehicle mix evaluation, and resource planning.

DESCRIPTION:

Domain: On road, off road (forests, farmlands, etc.), across gaps.

Span: Useful from individual vehicle or soldier level up to corps level.

Environment: Off-road area terrain ordinarily mapped in raster, roads and linear features in vector, and urban areas in raster or vector. Each type of terrain is described by factors that significantly influence mobility (e.g., soil strength, slope, surface roughness, vegetation, visibility, obstacles for off-road area terrain). The overall terrain description can be developed from TTADB, ITD, or similar terrain data bases produced by the Defense Mapping Agency. NRMM models weather effects on historical, near-real-time, and forecast bases; can model day and night mobility.

Force Composition: From single vehicles to vehicle mixes. Joint and combined forces, RED and BLUE.

Scope of Conflict: Can adjust vehicle mobility relative to battlefield damage. Rules can be set for restricting or eliminating mobility as a function of conventional, unconventional, or nuclear warfare.

Mission Area: All missions involving U.S. military ground vehicle mobility.

Level of Detail of Processes and Entities: Lowest entity is single vehicle, up to mixes of vehicles. Processes are primarily deterministic based on field-validated relations. Monte Carlo procedures are used in a limited way to interpret terrain and historical weather data. Vehicle mobility on road, off road, and across gaps is modeled primarily in a modular software format that compares pertinent vehicle and driver capabilities with those necessary to satisfy specified terrain, weather, and mission requirements.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-step model.

Treatment of Randomness: Mobility treated in deterministic fashion, terrain and historical weather by measured data, then limited Monte Carlo procedures.

Sidedness: Two-sided, symmetric. Single operator or multiple operators.

LIMITATIONS: Limited capability to model mobility in snow; presently does not model engineer-assisted gap crossing, avenues of approach, effects of military-emplaced obstacles, cover and concealment, and formation movement.

PLANNED IMPROVEMENTS AND MODIFICATIONS: In process of removing limitations and enhancing model capabilities.

INPUT: Prescribed digitized data describes vehicles, driver, terrain, weather, and scenario factors that have a significant effect on ground vehicle mobility for specified mission requirements.

OUTPUT: Maps, tabulations, and analyzed data are used to compare mobility capabilities of military ground vehicles and to evaluate mobility capabilities of competing ground vehicles in the military acquisition process.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computers with VMS operating system.
Storage:	40,000 blocks (35 MB).
Peripherals:	Minimum 1 terminal; can drive printers and graphics terminals.
Language:	FORTRAN 77.
Documentation:	Well-documented programmer's manual.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: For one quad sheet (22 km x 23 km), all terrain factors and ordinary resolution (100m for off-road terrain and 10m for roads and linear features); digitizing requires about one man-month. Vehicle, driver, and historical weather data is preprocessed and requires limited preparation time.

CPU time per Cycle: For one quad and normal terrain data resolution, about 2 minutes.

Data Output Analysis: Postprocessor provides graphical and textual information primarily in comparing the capabilities of available ground vehicles and in evaluating mobility capabilities in the military ground vehicle acquisition process.

Frequency of Use: Varies; used at least several times per year.

Users: U.S. Army Tank-Automotive Command, Material Systems Analysis Agency, Foreign Science Technology Center, participating NATO countries, U.S. Army Engineer Waterways Experiment Station.

Comments: NRMM is managed through a NATO technical management committee that meets every 12-18 months to consider and implement recommended mobility modeling changes in accordance with NATO procedures and priorities.

TITLE: N-SNAP - Non-Strategic Nuclear Attack Planning.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Pentagon, Washington, DC 20318-8000.

POINT OF CONTACT: Mr. Jim Hoffman, (703) 695-0895.

PURPOSE: N-SNAP is used to allocate a given mixed weapon arsenal with or without range restrictions to given target data at the theater nuclear level.

DESCRIPTION:

Domain: Land and sea.

Span: Accommodates any theater depending on data base.

Environment: Cell based.

Force Composition: Nonstrategic nuclear force.

Scope of Conflict: Nonstrategic.

Mission Area: Nonstrategic warfare.

Level of Detail of Processes and Entities: Aggregated.

CONSTRUCTION:

Human Participation: None.

Time Processing: Static.

Treatment of Randomness: Probabilistic damage assessment.

Sidedness: One-sided.

LIMITATIONS: Model measures prompt blast effects only.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Redesign and recoding.

INPUT: JRAD (336-character) target data base; user-supplied weapon, launcher, and wave-by-wave scenario files.

OUTPUT: Complete summaries of weapon expenditure and target damage assessment.

HARDWARE AND SOFTWARE:

Computer:	VAX.
Storage:	5,000 blocks.
Peripherals:	One printer and one VT 100 terminal.
Language:	FORTRAN 77.
Documentation:	Being developed.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Must have JRAD target data base.

CPU time per Cycle: 15-20 minutes.

Data Output Analysis: Statistical reports.

Frequency of Use: Almost daily.

Users: The Joint Staff/J-8.

TITLE: NUC-STRATEGYST.

DATE IMPLEMENTED: April 1989.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Room 1D940, Washington, DC 20318-8000.

POINT OF CONTACT: Peter C. Byrne, (703) 693-3248, AV 223-3248.

PURPOSE: NUC-STRATEGYST is a prototype research and evaluation tool. It is a resource allocation model that positions percentages of defensive resources in response to a posited strategic attack by nuclear weapons. It determines optimal BLUE defensive strategies in reaction to RED offensive strikes (or conversely).

DESCRIPTION:
Domain: Land and air.

Span: Global, strategic.

Environment: RED strategies are determined in terms of offensive weapon system allocations. BLUE strategies are defined in terms of defensive resource allocations (ABMs, shelters, space-based platforms, transportation, detection systems, funds, etc.). It employs game theory and linear programming to calculate a solution and differential equations to evaluate the results. The model is fast, responsive, and easy to use.

Force Composition: Forces are composed of numbers of offensive, strategic ballistic missiles and defensive ABMs. Model provides for Strategic Defense defensive measures.

Scope of Conflict: Nuclear, strategic, optimization model.

Mission Area: Addresses defensive resource allocations juxtaposed against a postulated strategic strike.

Level of Detail of Processes and Entities: Numbers of missiles and targets are highly aggregated to compute optimal strategies and to adjudicate combat.

CONSTRUCTION:
Human Participation: Required to define strategies.

Time Processing: Optimal strategy determination is a static process; combat adjudication is dynamic, time-stepped.

Treatment of Randomness: Deterministic optimization model. Combat adjudication, however, is based upon Lanchester attrition coefficients.

Sidedness: Two-sided, asymmetric. Can be executed by a single operator.

LIMITATIONS: This a prototype, highly aggregated, loosely coupled model. It currently requires several operations on two different computer systems to solve a problem.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The game-theoretic, optimization model executes on a VAX, whereas the linear programming problem is solved with a PC-based software package. These two parts are to be integrated into a single code. If the model is to be moved from prototype to production, a preprocessor to automate access of extant target bases and reformat the data into NUC-STRATEGYST inputs also remains to be accomplished. A user interface is required as well.

INPUT: Scenario development requires targets and target complexes. Users organize these target collections into strategies by designating offensive strikes and defensive resource levels. The model also requires Lanchester type attrition coefficients, target acquisition, and damage expectancy probabilities. Target worths are required as well.

OUTPUT: Two-person, zero-sum-game theory is applied to determine an optimal strategy. A mixed strategy is indicated in the event that a saddle-point does not exist. The methodology employs a system of Lanchester-type differential equations to determine the number of incoming strategic weapons that penetrate the defending antiballistic missile systems.

HARDWARE AND SOFTWARE:

Computer:	Currently runs on a VAX computer and on an IBM compatible PC (both are required).
Storage:	Minimum storage required.
Peripherals:	None.
Language:	SIMSCRIPT.
Documentation:	Technical Paper.

SECURITY CLASSIFICATION: Model without data is unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Small problems are solved in one to five minutes of CPU time.

Data Output Analysis: Produces hardcopy of intermediate and final results.

Frequency of Use: Not applicable to this prototype.

Users: There are no "production" users at this time.

Comments: N/A.

TITLE: NUCEVL - Non-uniform Coverage Evaluation, Version 2.3.

DATE IMPLEMENTED: October 25, 1990.

MODEL TYPE: Analysis.

PROPONENT: Mine Warfare Command, NAVSTA BLDG NS-1, Charleston, SC 29408-5500.

POINT OF CONTACT: Mr. Joseph Mattingly, Code N4C (803) 743-5405, AV 563-5405.

PURPOSE: NUCEVL is an operational support tool designed for the MCM Commander's staff to provide the capability to evaluate each phase of an MCM operation. The program calculates attained clearance level based on amount of effort applied.

DESCRIPTION:

Domain: Sea and undersea.

Span: Local.

Environment: All environmental data is implicitly specified through values users assign during MCM scenario specification.

Force Composition: Naval mines, mine countermeasures vehicles (MCMVs) and EOD.

Scope of Conflict: Conventional.

Mission Area: Sea control.

Level of Detail of Processes and Entities: Individual minesweepers and mines are not explicitly represented. Minesweepers are continuous rather than discrete entities. Mines are represented only in terms of their susceptibility to sweep tactics, and whether or not ship counts are used.

CONSTRUCTION:

Human Participation: Required. NUCEVL requires interactive input to specify the problem to be solved.

Time Processing: Dynamic, Closed form.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, asymmetric. One side nonreactive does not compute expected casualties.

LIMITATIONS: Math routines contained in NUCEVL assume a [illegible] effort applied must be in parallel tracks to a route. Program does not save or recall intermediate results from each day of an exercise.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improve user interface, add graphics routines and update algorithms to be consistent with the more rigorous COGNIT algorithms.

INPUT: Data describing MCM effort applied, mining threat, MCM system capabilities and, navigation error.

OUTPUT: Printed output of user input values and MCM clearance attained.

HARDWARE AND SOFTWARE:

Computer (OS): IBM-Compatible PC (MS-DOS).
Storage: 100K bytes.
Peripherals: Interactive keyboard, monitor and printer.
Language: ANSI Standard FORTRAN 77.
Documentation: COMINEWARCOM's Zenith MCM Planning and Evaluation Software Operator's Manual dated 25 October 1990. (Being updated by NAVTACSUPPACT.)

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minutes.

CPU time per Cycle: Minutes.

Data Output Analysis: Minutes.

Frequency of Use: As required during each MCM exercise.

Users: MCM Commander's staff.

TITLE: NUCWAVE - Nuclear Wave Attack System Model.

DATE IMPLEMENTED: 1971.

MODEL TYPE: Analysis.

PROPONENT: Vulnerability Analysis Branch (C312), Defense Systems Support Organization (DSSO), The Pentagon, Washington, DC 20301-7010.

POINT OF CONTACT: Denise Maykrantz, (703) 697-7421, AV 227-7421.

PURPOSE: NUCWAVE is used to determine the most advantageous placement of desired ground zeroes (DGZs) for potential targets and inventory of nuclear warheads. Either the total expected target value destroyed is maximized or the number of warheads to attain a damage level per target is minimized.

DESCRIPTION:
Domain: Land.

Span: Force posture studies.

Environment: Targets are a collection of force and other military targets, military and industrial installations, leadership headquarters, and population centers. Force targets are the foci of direct retaliatory threat. Other targets are assigned values of priorities.

Force Composition: Strategic nuclear forces.

Scope of Conflict: Nuclear weapons.

Mission Area: Nuclear weapon allocations given a target data base, a stockpile of nuclear weapons, and attack objectives. The program determines and analyzes potential DGZ placements and selects the most effective.

Level of Detail of Processes and Entities: Individual targets are input, but are aggregated by the model into target complexes and aimpoints. Weapon systems are modeled to the specific load type. Characteristics of targets effect the amount of weapons necessary to achieve the final results.

CONSTRUCTION:
Human Participation: Required for setup, but not required during execution. Several iterations may be run using massaged data developed by other model(s).

Time Processing: Static.

Treatment of Randomness: Deterministic. NUCWAVE is an expected value, computerized nuclear weapon allocation and damage assessment model.

Sidedness: One-sided.

LIMITATIONS: There is a maximum of 3000 targets per complex. However, the number of target complexes is unlimited.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The use of the optimal height of burst needs to be enhanced. The ability to minimize or maximize collateral damage to specific targets is also required.

INPUT: NUCWAVE requires a set of job instructions in NAMELIST format, a target data base in JAD format, and a weapon inventory. In multiwave mode, reduced value data is required.

OUTPUT: Numerous summaries are produced. DGZs are available to SIDAC strike formats. Target damage is available in JAD format.

HARDWARE AND SOFTWARE:

Computer:	IBM 4341 OS/MVS or VMSP/CMS.
Storage:	2000K.
Peripherals:	Standard peripheral equipment: permanent file space. Further I/O devices needed for optional output files.
Language:	FORTRAN.
Documentation:	Limited.

SECURITY CLASSIFICATION: Confidential.

GENERAL DATA:

Data Base: Depends on time needed to develop a JAD and strike data base.

CPU time per Cycle: 1,000-targets per 1 minute CPU time, 10,000 targets per 15 minutes CPU time, and 60,000 targets per 150 minutes CPU time. These calculations are based on one wave, one weapon type, and potential phase and target data complexed and sorted on latitude and longitude.

Data Output Analysis: Depends on the number of targets and strikes.

Frequency of Use: As necessary for studies.

Users: DSSO, PA&E, and ISP.

Comments: NUCWAVE is used to create damage response functions for two other models used for PA&E analysis, MIDLAAM and GAINER.

TITLE: NUFAM III - Nuclear Fire Planning and Assessment Model III.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Mr. R. Barrett, (DSN) 295-1670 or (301)295-1670.

PURPOSE: Research and evaluation tool for corps and theater-level analysis. Used to support requirements and capability assessment studies of tactical nuclear forces arrayed in context of a theater battle.

DESCRIPTION:
Domain: U.S. and opposing land and air forces on a corps-sized frontage. Depth to 500 km from FLOT.

Span: Corps level model is routinely run for multiple corps to yield theater level results.

Environment: User defines unit locations to model based on terrain, posture and scenario. Model does not represent terrain features. Population centers are included for civilian damage/casualty avoidance.

Force Composition: Unit sizes are defined in data base. Intended for company or battalion representation of units. Both Red and Blue units represented.

Scope of Conflict: Nuclear only. Models one or more nuclear pulses occurring within a short period of time (less than or equal to 12 hr). Unit locations remain fixed, although the effect of movement is implicitly represented. No conventional attrition occurs during simulation, but should be reflected in unit strength prior to nuclear use.

Mission Area: Nuclear only.

Level of Detail of Processes and Entities:
Entities: Company or battalion maneuver unit; artillery and missiles by firing section or launcher, aircraft by sorties from air bases. Defined in data base.

Processes: Target acquisition, detailed fire planning, execution of nuclear pulses, assessment of damage to units. Movement implicitly represented. Damage represented is radiation to personnel and blast to equipment. No fallout. Weapons and effects are defined through data base to allow new weapons to be represented. Fire planning criteria defined through data base to allow for variations in fire doctrine.

Time: Discrete event driven model.

CONSTRUCTION:
Human Participation: Not required outside of preparation of input data.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic (Monte Carlo). Ten runs are normally required to yield reasonable means.

Sidedness: Two-sided, symmetric in logic, asymmetric in data output values and data driven doctrine.

LIMITATIONS: No conventional or chemical play. No explicit movement of units.

INPUT: Unit locations and characteristics; nuclear weapons characteristics and effects. Parameters defining acquisition, movement, and fire planning logic. Size and location of population centers.

OUTPUT: Postprocessor produces 30 reports. Typical results are units acquired, engaged, and defeated; weapons selected and fired.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1180/84.
Storage:	230 K (main); 140 K (extended).
Peripherals:	Calcomp plotter.
Language:	SIMSCRIPT II.5.
Documentation:	- CAA-D-86-2, NUFAM III User's Manual. - DTIC AD#B113173L.

SECURITY CLASSIFICATION: Unclassified, without data.

GENERAL DATA:

Data Base: Data base prep: 1-6 weeks depending on number of excursions, etc.

CPU time per Cycle: Two-hours per repetition; 20-hours per excursion.

Data Output Analysis: Currently can produce up to 30 pre-defined reports. Postprocessor package (NUFAM-GAP) allows free-form data base queries and graphic displays.

Frequency of Use: Support in 1 to 5 studies/year.

User(s): U.S. Army Concepts Analysis Agency.

Comments: None.

TITLE: NUSSE-3 and NUSSE-3 (ATM).

DATE IMPLEMENTED: NUSSE-3: May 1987. NUSSE-3 (ATM): March 1988.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army CRDEC.

POINT OF CONTACT: Ron Pennsy, CRDEC, (301) 671-3570 or Dr. Camille D'Annunzio, The BDM Corporation, (703) 848-7471.

PURPOSE: The NUSSE-3 and NUSSE-3 (ATM) models may be used to describe the hazards, both liquid and vapor, from the release of a chemical munition. NUSSE-3, valid for low altitude release, and NUSSE-3 (ATM), valid for release at altitudes up to 20 kilometers, are mathematically formulated based on the tranrport and diffusion equations. Each model describes the chemical agent from the time of release to its ground impact, and then determines the vapor hazard until all of the agent has evaporated. NUSSE-3 (including the ATM version) may be used to estimate the area of liquid contamination, subsequent vapor contamination, and resulting chemical casualties. NUSSE-3 will handle gaseous, neat, or thickened agents dispensed from multiple munition types. NUSSE-3 methodology consists of describing the chemical cloud immediately after release, following the cloud to ground impact by determining the droplet transport by wind, evaporation, and transport and diffusion of the primary vapor. Ground contamination and lethal footprints are then calculated and the resulting vapor cloud (due to evaporation) is tracked in time.

DESCRIPTION:

Domain: Air and ground.

Span: Local. ATM Version requires actual weather data; Central Europe is available.

Environment: Considers temperature, speed, and wind direction.

Force Composition: N/A.

Scope of Conflict: Chemical warfare. Determines lethal footprints on the ground and subsequent vapor drift, and can be used to estimate chemical casualties.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:

Human Participation: Required to set up input file, then not permitted. The model is not interruptable.

Time Processing: Dynamic, time-step.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: Uses a simplistic algorithm for weather effects and does not take wind sheet into play. Also ground deposition grid is limited in size.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements in the ground deposition grid and the models graphics capabilities are underway.

INPUT: Includes munition data such as munition type, height of release, and type and quantity of agent. Meteorological information is estimated for NUSSE-3. The ATM version, however, requires actual weather data for the region of interest including wind speed and direction, temperature, pressure, and humidity.

OUTPUT: Includes ground concentration, lethal footprints, map-scaled overlays (these three may be done graphically), dosage/time, and vapor cloud tracking among others.

HARDWARE AND SOFTWARE:

Computer:	Models have been run on UNIVAC, CRAY, VAX-11/780, VAX/8600, and MicroVAX-II machines. The graphics package requires the availability of DISSPLA.
Storage:	N/A.
Peripherals:	One graphics terminal. Graphics version requires DISSPLA.
Language:	FORTRAN 77.
Documentation:	Published manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Depends on resolution desired; average run is approximately 50-60 CPU minutes on Micro-VAX II.

Data Output Analysis: Large text files that may be printed and graphic files.

Frequency of Use: Frequent when analyzing a chemical threat.

Users: CRDEC, CAA, BRL, BDM Corporation. Has also been given to France, NATO, and Israel.

Comments: Model is designed to give ball park estimates only. The NUSSE-3 models have been used to estimate the size and location of the chemical lethal footprint from a ballistic missile, to determine a keep-out altitude for chemical missiles and the effects of artillery chemical munitions, and to estimate chemical casualties. NUSSE-3 models may also be used to compare actual ground contamination area with the detectable contamination area.

TITLE: OBSERVE - Laser Observation Program.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis and training and education.

PROPONENT: U.S. Army Atmospheric Sciences Laboratory, SLCAS-AE-AE, White Sands Missile Range, NM 88002-5501.

POINT OF CONTACT: Dr. Harry J. Auvermann, (505) 678-4224, AV 258-4224.

PURPOSE: When used as an analysis model, OBSERVE serves as a research and evaluation tool that deals with combat development. It also deals with competing strategies of deployment and countermeasures to battlefield lasers. The model produces files containing data from which pictures of the appearance of a laser beam traversing a battlefield atmosphere can be made. The laser can be pulsed or continuous wave, scanning or pointing. The sensor can be staring, serial scan, or parallel scan. The picture represents the sensor display. The output can be transformed into printer images or video tapes. Video tapes can be used to gather statistical information on detectability of laser beams from a number of operators for selected scenarios. For training and education purposes, video tapes produced from model data can be used to train sensor operators in laser detection. The model will improve troop performance by developing the skills of individuals.

DESCRIPTION:

Domain: Land.

Span: Regimental battlefield.

Environment: Flat terrain, variable visibility, variable climate, simulated background, six degrees of freedom for laser, and sensor location and orientation.

Force Composition: Front line units.

Scope of Conflict: Deployment, RED or BLUE, of laser rangefinders, designators, and weapons. Deployment, RED or BLUE, television, image intensifiers, and thermal viewers.

Mission Area: Suppression of battlefield use of lasers.

Level of Detail of Processes and Entities: The model calculates the intensity of laser radiation scattered into the sensor by the device port and atmospheric particulates. The calculation is done for an array of picture elements that represents the sensor display. The intensity calculated this way is added to the background array of intensities that have been supplied by the analyst. The background array is derived, typically, by digitizing a photograph or infrared image of a representative scene.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Uniform battlefield conditions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrade to EOSAEL format.

INPUT: Weather, sensor, and laser data from ASCII files and background data from binary files.

OUTPUT: A series of data files on magnetic tape. Each file typically represents one frame of the sensor display.

HARDWARE AND SOFTWARE:
- Computer(OS): VAX 11/780 VMS.
- Storage: 200,000 bytes.
- Peripherals: Line printer and magnetic tape drive.
- Language: FORTRAN.
- Documentation: Internal, users guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minimal run time, two days for background.

CPU time per Cycle: One hour per 30 frames. A typical sensor produces 30 frames per second of real time.

Data Output Analysis: Once a video digital-to-analog converter has been united with a tape reader, a video tape can be produced in a few minutes.

Frequency of Use: Inactive.

Users: ASL.

Comments: Some of the branches of OBSERVE have not been completely debugged.

TITLE: OPAT - Orbit Propagation and Analysis Tool.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Avtec Systems Inc., 10530 Rosehaven St, Fairfax, VA 22020.

POINT OF CONTACT: Jeffrey G. Peiffer, (703) 273-2211.

PURPOSE: The Orbit Propagation and Analysis Tool is a research and evaluation tool, as well as an operation support tool. It can be used to model spacecraft orbits passing over areas of interest, and simulate different types of communications between space and ground.

DESCRIPTION:
Domain: Space and Ground.

Span: Global.

Environment: Orbits can be simulated to the accuracy required by the user, trading off speed for accuracy.

Force Composition: Joint and combined forces, both blue and red.

Scope of Conflict: Anti-satellite warfare, or ground-based warfare.

Mission Area: Spacecraft/Satellite modeling.

Level of Detail of Processes and Entities: Individual spacecraft are simulated. Earth oblateness, atmospheric drag, solar radiation pressure, and spacecraft maneuvering can be modeled. Individual ground stations and areas of interest are modeled.

CONSTRUCTION:
Human Participation: Required to initiate simulation.

Time Processing: Dynamic, time-stepped model.

Treatment of Randomness: Gaussian random noise can be added to simulation of sensors.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Simulation of spacecraft/ground communications is simplistic.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improve space/ground communications modeling.

INPUT: Orbital elements, ground station locations, areas of interest.

OUTPUT: Rise/Set times of spacecraft over areas of interest, limited sensor information.

HARDWARE AND SOFTWARE:
Computer: Designed to run on a Motorola MVME147 under UNIX.
Storage: 5 Megabytes.
Peripherals: Minimum requirements: 1 VT100 terminal.
Language: FORTRAN, C.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Contains inputs to simulation.

CPU time per Cycle: Depends on accuracy of orbital model.

Data Output Analysis: Analysis tool displays results of simulation in real-time or offline.

Frequency of Use: Used as required to simulate orbital dynamics.

Users: A DOD customer.

Comments: Can be easily configured to support other types of orbital analysis requirements.

TITLE: OPSURV - Operational Survivability Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Defense Nuclear Agency, Washington, DC 20305-1000, The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: William T. Cooper, (703) 848-7510 or Robert H. Sharify, (703) 848-6025.

PURPOSE: OPSURV is used to assess risk and measures to reduce risk for units under threat of nuclear, chemical, and conventional attack. Its applications include planning, training, and analysis of doctrines and issues related to survivability.

DESCRIPTION:

Domain: Land.

Span: Division/brigade area of influence.

Environment: Digitized terrain in 100m x 100m blocks that enable elevation and relative density.

Force Composition: Battalion and company components.

Scope of Conflict: Acquisition threat, chemical, nuclear, and conventional attack survivability.

Mission Area: All land-based division/brigade deployment with 200 km of the FLOT.

Level of Detail of Processes and Entities: All detection and targeting results based on individual company activity, location, composition, and lucrativeness factors can be displayed for battalion and company.

CONSTRUCTION:

Human Participation: No user interruption is needed; model is data-driven.

Time Processing: Static. Each run simulates a "picture" taken of the force deployment, performing detection analysis at any given instant.

Treatment of Randomness: Deterministic procedures for detection and verification. Stochastic, Monte Carlo procedures for targeting and attack results.

Sidedness: Two-sided, RED side (sensor deployment) nonreactive.

LIMITATIONS: The geographical area for gaming is restricted to stored digitized terrain data (currently 200 km in the vicinity of Fulda, West Germany).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Data on division, threat factors, and other parameters.

OUTPUT: Unit deployments on terrain are shown on a color monitor with symbols of units at high risk highlighted. The black and white monitor depicts unit data, lists of units at risk, and other output. Printouts of selected output can also be obtained.

HARDWARE AND SOFTWARE:

Computer: APPLE II Plus.
Storage: 10 MB.
Peripherals: CORVUS hard disk, black and white monitor, color monitor printer, joystick, videodisc player, PGS graphics system (SYMTEC), and VMI package.
Language: Pascal.
Documentation: Detailed user's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Two man-weeks.

CPU time per Cycle: Four hours.

Data Output Analysis: Raw data and graphics format.

Frequency of Use: Undetermined.

Users: DNA/U.S. Army Combined Arms Center and BDM.

Comments: None.

TITLE: OPUS1 - Optimal Preferential Utility and Strategies Program, Version 1.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAS), Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Capt. Misra, DSN 227-9702 or Commercial (703) 697-9702.

PURPOSE: OPUS1 is a computer program that evaluates effectiveness of a defensive system operating with preferential strategies.

DESCRIPTION:

Domain: Air and exoatmospheric.

Span: Global.

Environment: N/A.

Force Composition: BLUE on RED or RED on BLUE.

Scope of Conflict: Nuclear.

Mission Area: Strategic nuclear.

Level of Detail of Processes and Entities: Each offensive weapon (RV) has some probability, pK, of destroying the target at which it is aimed, and each interceptor has a probability, pI, of intercepting an RV to which it is committed. Both the offense and the defense must allocate their weapons for optimal effectiveness, but each is ignorant of its opponent's allocation. These allocations form a pair of preferential strategies, and the theory of two-person, zero-sum games provides a formulation by which each side can choose its best strategy.

CONSTRUCTION:

Human Participation: Required for initial input parameters and for refinements for each iteration.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided.

LIMITATIONS: Limitations on number of offensive nuclear bursts at each target and number of interceptors/RVs. Running model is a time-consuming process.

PLANNED IMPROVEMENTS AND MODIFICATIONS: RAND Corporation planning a new version.

INPUT: Probability of detection, probability of intercept, offense booster reliability, defense unit availability, etc.

OUTPUT: Provides an optimal offense and defense strategy given the initial input parameters.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage:
Peripherals: Terminal and printer.
Language: FORTRAN.
Documentation: User Manual.

SECURITY CLASSIFICATION: Unclassified (without data base).

GENERAL DATA:
Data Base: One man-week.

CPU time per Cycle: Six seconds on the STC 4080.

Data Output Analysis: One hour per iteration.

Frequency of Use: Varies with user.

Users: AFSAA/SAS, RAND.

Comments: None.

TITLE: ORDAM - Obstacle Removal Delay Assessment Model.

DATE IMPLEMENTED: January 1985.

MODEL TYPE: Analysis.

PROPONENT: The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Karen A. Stark, (703) 848-6258 or
John Chalecky, (703) 848-6374.

PURPOSE: ORDAM is used to evaluate the contribution made by area denial mines used in conjunction with runway cratering munitions to airfield duration of closure.

DESCRIPTION:
Domain: Land.

Span: Single airbase level.

Environment: Cratered and uncratered areas on airfield launch and recovery surfaces, and grassy areas to either side of the surfaces.

Force Composition: Component.

Scope of Conflict: Considers conventional runway cratering munitions an area denial mines.

Mission Area: Airfield attack.

Level of Detail of Processes and Entities: Individual vehicles and personnel are modeled. Processes modeled include tank dozers sweeping the minefield area, dismounted personnel employing small arms fire to detonate and destroy mines, and dismounted personnel using set charges to destroy mines in place. Movement and attrition are explicitly considered.

CONSTRUCTION:
Human Participation: Not permitted. Clearing methods to be employed are chosen in input preparation phase.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Minefield dimensions and densities are determined stochastically based on delivery system errors and mine dispersion parameters. Vehicle and personnel attrition is treated in a Monte Carlo fashion. In addition, mines with a self-destruction mechanism are explicitly modeled with a user-defined random self-destruct distribution.

Sidedness: One-sided.

LIMITATIONS: Does not consider sensor-fuzed, wide area mines.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Logic to handle target-activated fuzing, such as seismic, acoustic sensing.

INPUT: Requirements include attack system parameters such as size of attack, cratering munition and mine characteristics, clearing methods to be employed, their rates of operations, and their vulnerability to mine detonations.

OUTPUT: Produces distributions on the amount of time required to counter the various portions of the minefield.

HARDWARE AND SOFTWARE:

Computer:	Runs on DEC VAX series and IBM PCs and compatibles.
Storage:	Approximately 150 KB.
Peripherals:	No special requirements.
Language:	FORTRAN.
Documentation:	Limited.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Approximately one man-week.

CPU time per Cycle: Depends upon size of attack and clearing resources available. A typical case requires approximately five minutes on a DEC MICROVAX.

Data Output Analysis: Raw data and summary statistics are provided for ease of interpretation.

Frequency of Use: As required.

Users: U.S. Air Force Armaments Division, Commercial Concerns.

Comments: Normally used in conjunction with a number of BDM'S family of models.

TITLE: ORGAME - Oak Ridge National Laboratory (ORNL) Wargame.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Room 1D929, Washington, DC 20318-8000/Center for Modeling, Simulation, and Gaming, Martin Marietta Energy Systems, Inc., PO Box 2003, Bldg K-1001, MS 7170, Oak Ridge, TN 37831-7170.

POINT OF CONTACT: Dr. Dean S. Hartley III, (615) 574-7670.

PURPOSE: The Oak Ridge National Laboratory (ORNL) Wargame (ORGAME) is designed to provide planners with an automated tool to assist them in developing and quickly analyzing alternative plans for a contingency operation. It is similar to the State of the Art Contingency Analysis model (SOTACA), having developed from that model using alternative algorithms to meet user criticisms of SOTACA.

DESCRIPTION:

Domain: Land and limited air.

Span: From Low Intensity Combat (LIC) to about Brigade level.

Environment: Network based overlying a political area map. Distances of the links between nodes (roads, etc.) are input to account for subscale contortions. Transit time variations may also be included.

Force Composition: Joint and combined forces, Red and Blue, including such force elements as political influence.

Scope of Conflict: Nonnuclear, conventional and LIC.

Mission Area: Conventional and unconventional warfare, limited to the imagination of the user.

Level of Detail of Processes and Entities: Entities are military and political units which can be joined together and split up. Standard ground and air weapons can be played along with nonstandard weapons. Processes are battles between ground units that come in contact on the network and air sorties that approach within the range of ground or air weapons.

CONSTRUCTION:

Human Participation: Not required, interruptable with checkpoints and resets to earlier times.

Time Processing: Dynamic, time-stepped (variable during model run).

Treatment of Randomness: Can be run deterministically or stochastically (to determine spread of results) or perform sensitivity analysis.

Sidedness: Two-sided, symmetric, both sides reactive.

LIMITATIONS: Network upon which battles are fought must be predetermined. Battle script is required.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: An extensive user interface aids in the input of the scenario data, including building units and the network.

OUTPUT: Output consists of screen views of action and current status of forces, etc. Comparative charts are also available.

HARDWARE AND SOFTWARE:

Computer(OS): Designed to run on a VAX computer with VMS.

Storage: See SOTACA reference.

Peripherals: Tektronix 4237 graphics terminal and 4696 color (screen) printer and a DMA high speed link between the computer and the terminal. Otherwise like SOTACA.

Language: FORTRAN 77, PLOT-10 version 2 Standard Tektronix Interface language, and FORTRAN callable Tektronix terminal language subroutines.

Documentation: Manual describing differences from SOTACA.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of data base is similar to SOTACA (slightly shorter).

CPU time per Cycle: About 10 times faster than SOTACA.

Data Output Analysis: Output is immediately usable.

Frequency of Use: Not determined.

Users: Unknown.

TITLE: ORSBM - Oak Ridge Spreadsheet Battle Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis (but also used in calibrating exercise driver/training models).

PROPONENT: Center for Modeling, Simulation, and Gaming, Martin Marietta Energy Systems, Inc., PO Box 2003, Bldg K-1001, MS 7170, Oak Ridge, TN 37831-7170.

POINT OF CONTACT: Dr. Dean S. Hartley III, (615) 574-7670.

PURPOSE: The ORSBM is primarily a tool for extended face validation of more complex combat simulations. It also has potential use as a battle decision aid. The ORSBM is produces a rapid, rough-cut forecast of the results of a proposed battle (with upper and lower limits), based on historical data.

DESCRIPTION:
Domain: Land and limited air.

Span: A single battle (best results range from battalion to division sized).

Environment: Single inputs for each of climate/season, weather, terrain visibility, and temperature.

Force Composition: Any combination of national forces with inputs for number of personnel, armor, artillery, and daily combat air sorties.

Scope of Conflict: Conventional battles only.

Mission Area: Limited to the actual battle.

Level of Detail of Processes and Entities: Four entities are modeled: personnel, armor, artillery, and aircraft. Judgment factors (such as technology, leadership, and intelligence) and operational data (such as attack plan, defense scheme, and defense posture) are used to produce forecasts of battle duration, advance rate, total advance, surprise level, attrition, and victor. Each forecast includes low, expected, and high estimates.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Results are deterministically based on mathematical models of historical data. Random effects are included in the error distributions of the expected values, which are used to produce the spread of the results.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Low level of detail, results are stated with only one or two significant digits. Models an individual battle. Determination that such a battle will take place is external to the model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Internal mathematical models may be improved (fully validated), subject to funding.

INPUT: About three dozen input variables, covering nationality, forces, human factors, operational and environmental data, and desired confidence interval.

OUTPUT: About a dozen output variables (with spreads), either as printout or on screen display, and one plot indicating nearness of the input battle to historical norms (indicating confidence to be placed in the results).

HARDWARE AND SOFTWARE:

Computer(OS):	IBM PC compatible with DOS.
Storage	81 kilobytes (plus Lotus 1-2-3).
Peripherals:	Printer, if desired.
Language:	Lotus 1-2-3.
Documentation:	User's Manual and a document containing a thorough derivation of the mathematical models from the historical data.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Construction of the input data takes minutes.

CPU time per Cycle: About 2 seconds on a 80286 machine.

Data Output Analysis: Output is immediately usable.

Frequency of Use: Not determined.

Users: I Corps, Fort Lewis.

Comments: The ORSBM represents a mathematical model of available historical data on battle outcomes. As a result, it is a very broad brush model, with limited precision. It is not suitable for force mix or acquisition studies by itself. It may best be used as part of the validation process for more complex models or to calibrate training models. With additional validation through testing against an independent set of historical data, it may be useful as a combat operations decision aid at the tactical level.

TITLE: OSADS - Optical Signature Acquisition and Detection Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: WRDC, Avionics Laboratory, Analysis and Evaluation Branch (WRDC/AAWA), Wright-Patterson AFB, OH 45433-6543.

POINT OF CONTACT: Mr. Bill McQuay, (513) 255-2164.

PURPOSE: OSADS calculates air vehicle detectability for man-in-the-loop EO or visual sensor systems. The model is capable of simulating the optical environment and determining the perceived optical characteristics (optical signatures) of the target. These optical signatures, along with the environmental and sensor performance parameters, are used to determine target detectability.

DESCRIPTION:

Domain: Land, sea, and air.

Span: Individual.

Environment: The model can simulate a clear day only. The direct solar illumination, skylight illumination, and upwelling illumination are represented. The solar illumination is described using the solar constant at the top of the atmosphere attenuated by the "optical thickness" of the atmosphere to the altitude in question.

Force Composition: One target vehicle and one observer.

Scope of Conflict: No weapons are modeled.

Mission Area: Optical region.

Level of Detail of Processes and Entities: A single target vehicle is modeled. The model produces a probability of detection and an apparent contrast map. The contrast map levels are defined as follows: negative contrast, identified by the numbers 0, 1, 2, 3, or 4, represents a target element that is darker than the background; positive contrast, identified by the numbers 5, 6, 7, 8, or 9, represents a target element that is brighter than the background.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Target track or flight profile data set, input parameter file and the target shape description data set.

OUTPUT: The output data file produced contains a list of the input parameters. It also identifies the total number of nodes in the target shape description. In addition, the user can choose a plotting option that creates a graphical depiction of the target.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780.
- Storage: 470,016 bytes.
- Peripherals: No special requirements.
- Language: FORTRAN IV.
- Documentation: User's guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: 93 seconds.

Data Output Analysis: Manual analysis of tabular results.

Frequency of Use: Varies depending on requirements.

Users: Primarily WRDC/AAWA.

Comments: N/A.

TITLE: OSAMM - Optimum Supply and Maintenance Model.

DATE IMPLEMENTED: Original release - 1983; Release 2.0 - 1987.

MODEL TYPE: Analysis.

PROPONENT: HQ CECOM, ATTN: AMSEL-PL-SA, Fort Monmouth, NJ 07703-5004.

POINT OF CONTACT: Mr. Owen Robatino, AV 992-4381, (908) 532-4381.

PURPOSE:

A. The OSAMM can be used as a Research & Evaluation Tool for Logistic Support Analysis (LSA). It performs Level of Repair Analysis (LORA) on new and existing equipment. This includes weapon systems as well as support equipment. The OSAMM can deal with a system's development by determining the impact of system design on logistics support.

B. It should be noted that the OSAMM can be used during any phase of a system's life. It can be used to determine the maintenance concept of an equipment prior to fielding or to reconsider the maintenance concept of an equipment after fielding. It determines the most cost effective maintenance concept and initial spares placement for an equipment, subject to an availability requirement.

DESCRIPTION:

Domain: Land.

Span: Global.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Entity: Line Replaceable Units (LRUs) and Shop Replaceable Units (SRUs) within an equipment. Test equipments and repairmen used to repair the equipment. Maintenance and supply echelons for the equipment. Processes: Repair of end item, LRUs, and SRUs. Supply of LRUs, SRUs, and piece parts.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic, generating values as a function of expected values.

Sidedness: N/A.

LIMITATIONS: OSAMM is not a Wargaming or Simulation model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Being determined by U.S. Army Materiel Command Materiel Readiness Support Activity (MRSA).

INPUT: LRU/SRU breakdown, logistic structure, Reliability and Maintainability (RAM) data, inventory cost parameters, Order-Ship Times (OSTs), Turnaround Times (TATs), operational availability target.

OUTPUT: Repair level decisions, spares requirements, test equipment and repairmen requirements, costs, operational availability.

HARDWARE AND SOFTWARE:

Computer:	Control Data Corporation (CDC) Network Operating System (NOS).
Storage:	Unknown.
Peripherals:	Terminal, line printer.
Language:	FORTRAN.
Documentation:	OSAMM Release 2.0 User's Guide - DTIC ADA 187675. OSAMM Technical Documentation - DTIC ADB 115385.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Depends on the user's knowledge of LSA, OSAMM, and the equipment being modeled.

CPU time per Cycle: Depends on the complexity of the equipment being modeled.

Data Output Analysis: Depends on the user's knowledge of OSAMM.

Frequency of Use: Varies by activity, but is used at least several times per year by those listed below.

Users: CECOM, AMSAA, MRSA, AMCCOM.

Comments: OSAMM uses algorithms of the Selected Essential-Item Stockage for Availability Method (SESAME) model, which is the standard Army model for calculating initial sparing quantities subject to an availability requirement.

TITLE: Osprey - Space Defense Effectiveness Model.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: Teledyne Brown Engineering, 1250 Academy Park Loop, Suite 240, Colorado Springs, CO 80910.

POINT OF CONTACT: Wayne Grissom, (719) 574-7270.

PURPOSE: Osprey is a research and evaluation tool that models the Army ASAT JPO's ground-launched KEW antisatellite weapon, as well as the Air Force's conceptual ground-based laser ASAT weapon. Osprey uses these ASAT weapon systems, individually or in combination in a stochastic, Monte Carlo simulation of a Space Defense battle involving ASAT weapon systems, resident and replacement targeted satellites, ground-based space surveillance (radar & optical) network, and a finite capacity communications network linking all the BM/C3 nodes from the NCA to the individual weapon/surveillance sites. The program's output is in the form of tabulated data (printouts) and data files which may be inputted to local user generated plotting programs.

DESCRIPTION:

Domain: Surface and space operations.

Span: Global; may be used to model U.S. ASAT attacks on USSR satellites (current data base) or USSR ASAT attacks on U.S. satellites.

Environment: Models major system/subsystem elements of each ASAT weapon system. Models the surveillance network's ability to detect, track, and identify space objects. Models the specific messages that must flow to and from the NCA and remote sites. Models several BM policies affecting the operation of the weapons and surveillance system.

Force Composition: ASAT systems: ground launched KEW missile, ground-based laser, Surveillance systems: tracking and detection radars (dish and phased array types) detection radars (fixed fan).

Scope of Conflict: Conventional ASAT war in space and the supporting ground operations.

Mission Area: Space Defense.

Level of Detail of Processes and Entities: MTBFs and MTTRs of all major systems; angular coverage and functional capabilities of the surveillance sensors; ground launched ASAT missile: launch pad operations, mission data preparation, ballistic performance of the missile, target acquisition and end-game; GBL ASAT: prefire ground operations; laser operation during the attack, post attack operations, mission data preparation, target acquisition and tracking.

CONSTRUCTION:

Human Participation: Not Required. Event-Stepped.

Time Processing: Dynamic.

Treatment of Randomness: Stochastic. Monte Carlo (however, certain entities like the MTBF/MTTRs may be fixed).

Sidedness: One-sided.

LIMITATIONS: 200 satellites, 4 ground launched ASAT bases, 4 GBL bases, 35 surveillance sites, 250 wars.

PLANNED IMPROVEMENTS AND MODIFICATIONS: GBL model being upgraded to cope with target countermeasures. COMM model to be changed to more accurately reflect combined ground-launched missile and GBL operations.

INPUT: Via data file using a Namelist (FORTRAN) format.

OUTPUT: Both formatted and unformatted data files containing tabular data reflecting the inputted data base and statistical summaries of the wars that were run.

HARDWARE AND SOFTWARE:

Computer(OS): Any computer with a good FORTRAN compiler and at least 4 MB of RAM to load the executable. (Has been run on VAX's, SPARC workstations, Silicon Graphics and 80386 PCs).

Storage: Source: 2MB, Executable: 4MB, Data: at least 1MB.

Peripherals: Printer and/or monitor (B&W - okay), a means of loading the program files into the computer.

Language: FORTRAN 77.

SECURITY CLASSIFICATION: Unclassified, For Official Use Only. Classified input data will classify the outputted data.

GENERAL DATA:

Data Base: Current data base contains data describing the nominal U.S. Army KEW ASAT and U.S. Air Force DEW weapon systems. The U.S. Space Surveillance Network is accurately modeled. The COMM (C3I) model is fully detailed.

CPU time per Cycle: CPU time per war is dependent on the CPU and on the number of ASAT bases, targets, and surveillance sensors. Example: Compaq 386/20 with Weitek 1167 coprocessor; 1 ASAT base, 20 targets, and 21 sensors: 60 sec/war.

Data Output Analysis: Analyst must at least access the main output file and review the statistical summary tables.

Frequency of Use: Has been used by the Air Force since 1981 and by the Army since 1985. Usage is sporadic, but nearly continuous (yearly basis).

Users: Army Missile and Space Intelligence Center (MSIC); Army ASAT JPO; Air Force Operational Test and Evaluation Center (AFOTEC).

Comments: Configuration control managed by the Proponent (above).

TITLE: PACAM 8 - Piloted Air Combat Analysis Model.

DATE IMPLEMENTED: December 1985.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: PACAM 8 is a simulation model for air-to-air fighter analysis.

DESCRIPTION:
Domain: Air.

Span: Mission.

Environment: Air engagement only.

Force Composition: Opposing flights of aircraft, SAMs, and laser weapons.

Scope of Conflict: Conventional weapons.

Mission Area: Counterair.

Level of Detail of Processes and Entities: PACAM 8 can model up to 8 aircraft and 16 missiles in the air simultaneously as well as 10 SAM sites and 4 AAM types. Other modeling capabilities include allowance for radar clutter, IR background noise effects, as well as unorthodox control force submodels to evaluate flight performance, dynamics, and tactics of advanced fighter aircraft.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time and event-step.

Treatment of Randomness: Deterministic or stochastic mode available. Kill determination is stochastically provided by an optional Monte Carlo detection process based on a function of the signal-to-noise ratio.

Sidedness: PACAM 8 is a two-sided asymmetric model in which both sides are reactive.

LIMITATIONS: The model assumes that all aircraft enter combat flying straight and level, that all aircraft are provided perfect information, and that received information is shared among partners.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: PACAM 8 inputs consist of the number and types of aircraft simulated, scenario information, AAM type, SAM type, weapons release conditions, tactics used, laser data, and detection contours.

OUTPUT: PACAM 8 produces a standard report consisting of reflective inputs, aircraft position, orientation, maneuver state, and information state.

HARDWARE AND SOFTWARE:

Computer: VAX.

Storage: 2.4 MB.

Peripherals: N/A.

Language: FORTRAN V.

Documentation: PACAM 8 User's Manuals, PACAM 8 Analyst Manuals.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: PACES - Performance Analysis for Communications-Electronics Systems.

DATE IMPLEMENTED: 1970.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Grounds, Attn: [STEEP-(T-E)], Fort Huachuca, AZ 85613-7110.

POINT OF CONTACT: Mr. Steven C. Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: An operational support tool or decision aid, PACES is used to assist in conducting compatibility and vulnerability analyses of communications and electronic equipment and systems in tactical deployments. The output is used to determine whether systems are suitable for deployment.

DESCRIPTION:

Domain: Land and air; limited space and naval.

Span: Accommodates any theater depending on data base. Can model individual equipment to full corps and above deployments.

Environment: Detailed RF phenomenology model. Models the effect of terrain and ground constraints in either an area-prediction or a point-to-point mode. Can use DMA digitized terrain data as input. Effects of time of day, month, and climatology considered for various propagation models.

Force Composition: Joint and combined: BLUE, GREY, RED.

Scope of Conflict: Conventional warfare.

Mission Area: All phases of conventional warfare.

Level of Detail of Processes and Entities: Uses deployment data concerning the location, terrain, and required linking of communications-electronics (C-E) equipment contained in a tactical force to calculate the communicability, compatibility, and vulnerability of the C-E systems. Samples a required number of links and initially determines the probability of communication (compatibility) over a link without interference. This probability is based on equipment, technical performance, characteristics, and propagation losses. Then computes the propagation loss for each possible interferer and computes a desired versus interferer signal ratio. Next is computation of the probability of correct information transfer (compatibility) using previously measured performance data (scoring) for each particular kind of C-E equipment. The effects of jamming (vulnerability) on each link are similarly calculated by substituting the jammer as the interferer. ESM functions of intercept and DF are also modeled. For DF, the model can produce both a numerical probability of DF and an associated CEP value.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: Static.

Treatment of Randomness: Can be run in either deterministic or probabilistic mode. Monte Carlo options are available for estimations of propagation variables from the mean.

Sidedness: N/A.

LIMITATIONS: Does not model specific effects of foliage or urbanization.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Propagation modules are under study for enhancement and computer graphical development for file updates, data validation, and model output presentations.

INPUT: Tactical deployment data, equipment technical performance characteristics, propagation path loss parameters, message traffic data.

OUTPUT: Printout and disk files of probability of C-E equipment and systems communicability, compatibility, and vulnerability performance in their intended tactical operational environment. Output files can be postprocessed using standard statistical packages.

HARDWARE AND SOFTWARE:

Computer:	CDC CYBER 180 Model 830.
Storage:	Variable; requirements can be adjusted.
Peripherals:	Optimum number of disks and tape drives varies; variable mass storage requirements in size of data files determine requirements.
Language:	SLACS 5 (an extended FORTRAN 77).
Documentation:	Extensively documented with four manuals published.

SECURITY CLASSIFICATION: Unclassified but data bases are often classified.

GENERAL DATA:

Data Base: Preparation of complete new corps-size deployment with appropriate RED forces requires one year. Analysis requiring data modification for specific test system requires one to two months, depending on system.

CPU time per Cycle: Depends on deployment size and number of equipment to be evaluated. Corps-size deployment can take 100 hours of CPU time.

Data Output Analysis: Hardcopy printouts and disk files suitable for postprocessing.

Frequency of Use: Varies; four to six analyses performed per year.

Users: Model is resident at U.S. Army Electronic Proving Grounds. EMC/EMV analyses have been performed for a variety of government agencies.

Comments: Model is not machine dependent but takes advantage of the CDC CYBER 60-bit word for optimizations of data storage and access and would require modification for other environments.

TITLE: PACHEM - Point Area Chemical Effects Model.

DATE IMPLEMENTED: 1983-1984.

MODEL TYPE: Analysis.

PROPONENT: AL/CFHD, Wright-Patterson Air Force Base, OH 45433-6573.

POINT OF CONTACT: Dr. C.R. Replogle, DSN 785-7583, Commercial (513) 255-7583.

PURPOSE: PACHEM simulates the expected area coverage of a target (e.g., an air base) by challenge level (concentration, dosage, deposition) and estimates casualties resulting from a single attack with one or more chemical munitions.

DESCRIPTION:
Domain: Land.

Span: Local.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: Chemical warfare.

Mission Area: Air base operations.

Level of Detail of Processes and Entities: PACHEM uses the contamination pattern produced by a single munition (output from a chemical transport-diffusion model such as NUSSE 4 to overlay and determine the cumulative effects of multiple munitions of a single type and agent fill. The target area may be subdivided into multiple subtargets. The distribution of personnel within the target is an input, as is the agent dose response function and the mask and ensemble don times. The contamination pattern overlay is onto a grid of user specified resolution. The contamination values at each grid point and within each grid sector are used to compute the estimates of area coverage versus deposition, concentration, dosage, and particle size. The contamination values are used in conjunction with the dose response function, personnel distribution, and mask and ensemble don times to compute casualty rates.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, contamination reported for specified time.

Treatment of Randomness: Stochastic, Monte Carlo representation of multiple trials.

Sidedness: One-sided.

LIMITATIONS: Produces snap-shots of challenge and expected casualties (no time history provided), limited to single attack, single agent, and assumes personnel are stationary throughout the contamination period.

INPUT: Agent dispersion patterns, target and subtarget definitions, population definitions, toxicity data (dose response curves), attack scenario (munition targeting, delivery methods/errors), target grid resolution.

OUTPUT: Estimated casualties, challenge level statistics (dosage, deposition, concentration and drop size area coverage), target challenge patterns.

HARDWARE AND SOFTWARE:

Computer(OS): Any system with a FORTRAN compiler.
Storage: 10 MB.
Peripherals: None required.
Language: FORTRAN 77.
Documentation: User Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: No data base required.

CPU time per Cycle: Less than 30 minutes.

Data Output Analysis: Postprocessor aids in analysis of output.

Frequency of Use: Weekly.

Users: JAYCOR.

Comments: Model developed by JAYCOR, Dayton, Ohio, under USAF contract to AL/CFHD, WPAFB, OH.

TITLE: PANTHER Tier I - Low Intensity Conflict Simulation.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Combined Arms Command-Training, ATTN: ATZL-CTS-BB, Ft. Leavenworth, KS 66027-7301.

POINT OF CONTACT: MAJ Velez or MAJ Koone, AV 552-3189/ 3395, Commercial (913) 684-3189.

PURPOSE: To train battalion and brigade level commanders and staffs on staff coordination in a Low Intensity Conflict (LIC) environment.

DESCRIPTION:
Domain: Land, air and rivers.

Span: Local, tactical level.

Environment: Any terrain, weather, time or day.

Force Composition: Joint, combined at tactical level.

Scope of Conflict: LIC.

Mission Area: Focuses on level of detail of processes and entities. Models down to an individual soldier, aircraft or piece of equipment. In a combat engagement, model will deploy units by equipment, munitions and personnel (WIA, KIA, MIA; WIA it describes wounds). Model processes all civil affairs, PSYOP, combat actions by zones. This provides the basis for changes in popular support of the legitimate government forces.

CONSTRUCTION:
Human Participation: Required for decisions.

Time Processing: Static.

Treatment of Randomness: Stochastic; Monte Carlo.

Sidedness: Two-sided, symmetrical.

LIMITATIONS: Requires one computer per battalion. Information from one battalion can not be cross referenced/used by other battalions.

PLANNED IMPROVEMENTS AND MODIFICATION: Write program in spanish. Modify software to make system more user friendly.

INPUT: Scenario, OPORD, order of battle.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:
Computer (OS): IBM XT/AT MS DOS.
Storage: 10 MB.
Peripherals: High Speed Printer.
Language: Turbo Pascal 5.5.
Documentation: Basic Rules, How to Train Manual, Organizer's Manual and Computer Operator's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 8 hours.

CPU time per Cycle: Unknown.

Data Output Analysis: N/A.

Frequency of Use: As required.

Users: U.S. Army tactical units, Latin American CGSC and AOC equivalent schools.

TITLE: PANTHER Tier II - Low Intensity Conflict Simulation.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Combined Arms Command-Training, ATTN: ATZL-CTS-BB, Ft Leavenworth, KS 66027-7301.

POINT OF CONTACT: MAJ Velez or MAJ Koone, AV 552-3189/3395; Commercial (913) 684-3189.

PURPOSE: To train U.S. country team members, unified command staffs, and high level host nation staffs in nation building activities in a Low Intensity Conflict (LIC) environment. To have training audience update host nation Internal Defense and Development (IDAD) and U.S. Foreign Internal Defense (FID) campaign plans.

DESCRIPTION:

Domain: Land and air, limited sea operations.

Span: Global, theater, national, and regional.

Environment: All.

Force Composition: None, role playing model.

Scope of Conflict: Conventional and unconventional warfare.

Mission Area: Focuses on IDAD and FID campaign plan development.

Level of Detail of Processes and Entities: No entities. Role players input coordination and project worksheets into the computer which then allocates or cancels programs and records affect on population over a period of time.

CONSTRUCTION:

Human Participation: Required for decisions.

Time Processing: Static.

Treatment of Randomness: Stochastic; Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Computer program not very user friendly.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Write program in Spanish. Modify software to make system more user friendly. Incorporate RDSS model.

INPUT: Coordination and project budget worksheets.

OUTPUT: Computer printout, graphs and charts.

HARDWARE AND STORAGE:

Computer:	IBM XT/AT MS DOS.
Storage:	10 MB.
Peripherals:	High speed printer.
Language:	Turbo Pascal.
Documentation:	Controller Manual, Playor Manual, Role Description, Counter Insurgency Scenario, and Master Events Listing.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 4 hours.

CPU time per Cycle: Unknown.

Data Output Analysis: N/A.

Frequency of Use: As required.

Users: U.S. Army CGSC IDAD course students, JFKSWC FID/IDAD course students.

TITLE: PARACOMPT - Parametric Analysis of Respiratory Agents Considering Operations, Motivations, Protection, and Time.

DATE IMPLEMENTED: Early 1960s.

MODEL TYPE: Analysis.

PROPONENT: CRDEC, Studies & Analysis Office, Aberdeen Proving Ground, MD 21010-5423.

POINT OF CONTACT: Mr. Richard zum Brunnen, (301) 671-3570, AV 584-3570.

PURPOSE: PARACOMPT simulates a chemical battlefield warfare scenario. It performs a comprehensive assessment and evaluation of target area coverage and personnel casualty estimates. It was initially designed to perform evaluation studies of the effectiveness of developmental and standardized chemical munition systems. It was later designed to examine combat operations of troops taking MOPP protective action as a function of time.

DESCRIPTION:

Domain: Land: flat, open terrain.

Span: Targets can be characterized from platoon to battalion size.

Environment: Static battlefield with steady-state meteorological conditions.

Force Composition: BLUE or RED unit characterization.

Scope of Conflict: Chemical warfare.

Mission Area: Chemical combat missions.

Level of Detail of Processes and Entities: This is a high resolution assessment methodology. Highly detailed characterization of chemical cloud patterns and target units can be evaluated in fine increments of time and space.

CONSTRUCTION:

Human Participation: Not permitted after initial inputs have been set up and program executes.

Time Processing: Snapshots are taken of battlefield situation at specific time periods or intervals.

Treatment of Randomness: Stochastic, Monte Carlo simulation of munitions being delivered onto a target area. The program determines statistics on mean and standard deviation for casualties and area coverage.

Sidedness: One-sided simulation of a battlefield chemical warfare scenario.

LIMITATIONS: User needs access to a mainframe with considerable memory available.

PLANNED IMPROVEMENTS AND MODIFICATIONS: This model has recently undergone an extensive redesign and code improvement effort. The new code is currently being retested and verified for accuracy. The input requirements for setting up and stacking the many run cases have undergone an extensive modification and simplification effort. Even though the use of this model is still "batch processing," simplifying the input has made it much more usable.

INPUT: The program operates in a "batch" predeveloped input data set mode. The main inputs are number of replications, delivery errors, aim points, number of rounds fired, single munition chemical cloud grid, target sizes and location, and personnel agent dose-response parameters for casualty estimation.

OUTPUT: The main outputs are calculated casualties and area coverage levels for each target as well as a composite grid of dosage and deposition values that results from overlapping of multiple rounds.

HARDWARE AND SOFTWARE:

Computer: Currently runs on the UNIVAC 1100/60 system.
Storage: Approximately 3500 lines of code.
Peripherals: Minimum requirement: one printer.
Language: ASCII Standard FORTRAN 77.
Documentation: Technical report is available on the current program. Another technical report and user's guide on the "new and improved" program version will soon be available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Setting up the target array is the most time-consuming effort. Setup time varies from minutes to a half hour.

CPU time per Cycle: A typical UNIVAC 1100/60 run takes from 45-90 seconds of core time. CPU time depends upon input data base of conditions for simulation of desired scenario. Execution time increases directly as the setup and simulation of the battlefield scenario increase in complexity.

Data Output Analysis: No postprocessor is available for analysis of output results.

Frequency of Use: Regular usage within CRDEC varies from daily to monthly.

Users: CRDEC, NRDEC, AMSAA, Air Force, Honeywell, BDM.

Comments: PARACOMPT has been used with a number of different cloud generators in the past, but has most recently been used with the NUSSE type of methodology since NUSSE3 can generally characterize most types of chemical agents. PARACOMPT has a unique feature that enables it to be used to evaluate variable height of functioning chemical munitions.

TITLE: PASTE - Penetration Assessment of Terminal Engagements.

DATE IMPLEMENTED: Approximately 1967 - 1968.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplane Company,
ATTN: D.D. Genzlinger, P.O. Box 3707, Seattle, WA 98124.

U.S. Army Missile Command,
ATTN: AMSMI-OR-SA (Mr. Wayne M. Leonard), Redstone Arsenal, AL 35810-3215.

POINT OF CONTACT: Boeing: Darrell D. Genzlinger, (206) 655-4816.

U.S. Army Missile Command: Wayne M. Leonard, (205) 876-0500, AV 746-0500.

PURPOSE: The PASTE model performs an expected value analysis for calculating the dynamic status of a penetrator's survivability during a terminal engagement between a Soviet SAM and an attacking penetrator. The simulation aids in evaluating the effectiveness of penetrator characteristics, such as radar cross section, speed, maneuverability, and flight altitude. It also evaluates the effectiveness of the missile defense system during a terminal engagement. PASTE is a one-on-one engagement simulation that incorporates a shoot-look-shoot firing doctrine by the defense. In addition, however, it can process many one-on-one engagement games during a single computer run. Although the program was originally written to simulate, in high-level detail, the engagement game of a SAM defense site engaging the SRAM, it can be used for any penetrator flying a predefined path.

DESCRIPTION:
Domain: Can be a combination of land, sea, and air.

Span: Local or individual.

Environment: Terrain relief, terrain cultural features, and sea states.

Force Composition: N/A.

Scope of Conflict: Conventional, with some nuclear effects.

Mission Area: Indirect artillery (fire support and air defense).

Level of Detail of Processes and Entities: Entity: Individual aircraft or missile. Processes: Attrition and movement of entities.

CONSTRUCTION:
Human Participation: Not permitted during execution.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Hybrid: stochastic (direct computation, but SAM missile flyout trajectory can be Monte Carlo) and deterministic (generates a value as a function of an expected value).

Sidedness: One-sided with no further subclassification.

LIMITATIONS: Only one penetrator and 70 SAM sites; a limited number of missiles per SAM site, components of a penetrator, and glint points.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Currently none.

INPUT: Soviet SAM characteristics, such as sites and limitations to their radars and missiles, as well as input of penetrator itself, which includes RCS, blast kill radius, sure safe radius, and a trajectory.

OUTPUT: Detailed penetrator data, computed miss distance, table lookup for kill analysis, and fragmentation kill analysis available.

HARDWARE AND SOFTWARE:

Computer:	DEC-VAX 11/780 and 785; APOLLO (all models); and IBM-360, 370, and 332.
Storage:	5000-8000 lines of code, 2000-3000, lines of data.
Peripherals:	Printer.
Language:	FORTRAN 77.
Documentation:	Boeing document D448-10900.

SECURITY CLASSIFICATION: Model without data is secret.

GENERAL DATA:

Data Base: One week to two months required to prepare data base.

CPU time per Cycle: Depends on computer type, penetrator's speed, RCS, altitude, type of SAM system, and number of parametric cases per run concurrently if ECM techniques are used and end game analysis is performed. If user is printing miss distance output with 12 parametric offset fly by cases while flying a 1.5 Mach, 1 square meter RCS at 4000 feet altitude penetrator against an SA-12 (Gladiator) missile with no ECM, it will take 108 CPU minutes on a VAX 11/780 computer.

Data Output Analysis: Depends on type of analysis and number of parametric cases for a single cycle.

Frequency of Use: Used continually.

Users: Boeing, AFCSA, and U.S. Army Missile Command Systems Analysis Office.

Comments: Other models used in conjunction with PASTE: Terrain Model, FATE RCS, and TRAJGN-trajectory generator model.

TITLE: PATROL.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: U.S. Coast Guard R&D Center, Marine Systems Branch, Avery Point, Groton, CT 06340-6090.

POINT OF CONTACT: Clark Pritchett, (203) 441-2653, FTS 642-2653.

PURPOSE: PATROL is designed to compare the capabilities of alternative vessels in law enforcement patrols that are being considered for acquisition. PATROL is currently a research and evaluation tool dealing with force capability and requirements. It could also be used as operation support tool.

DESCRIPTION:

Domain: Coastal and ocean.

Span: Individual vessel.

Environment: Sea state distribution and limiting sea states.

Force Composition: One Coast Guard cutter plays against a mix of many potential violators.

Scope of Conflict: Limited to patrolling functions in which the adversary does not shoot back.

Mission Area: Coast Guard Law Enforcement patrols. With modifications, it could be used for naval operations such as Marketime.

Level of Detail of Processes and Entities: A patrol is broken up into phases (e.g., search intercept), which are separated by events (e.g., detection). Input information is organized into four areas: vessel, traffic, area. and operations. This information is processed to produce times in each phase of the patrol and a probability transition matrix. A Markov model is solved to give long-term times in each phase of the patrol, number of events (e.g., seizures), and logistics information such as fuel consumed and miles traveled. Various MOEs that relate to the goal of the patrol are computed.

CONSTRUCTION:

Human Participation: Required for gathering input information.

Time Processing: Automatically by program.

Treatment of Randomness: Distributions of traffic and environment are input to produce average values used by Markov model, which is deterministic.

Sidedness: Can be played either way. For example, single vessel characteristics or traffic distribution can be changed.

LIMITATIONS: The traffic does not shoot back. There is no engagement phase in the model. C3I is accounted for in the inputs, not dynamically.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Graphics for inputs and outputs are planned for the future.

INPUT: Vessel operating and engineering characteristics (speed in a seaway, fuel consumption curve, tankage, etc.) describe the vessel. Traffic is broken into categories and described by arrival rates. Policy, strategy, and tactics are explicitly accommodated.

OUTPUT: Compressed into three pages that describe patrolling vessel effort, performance, and logistics. Detailed information is also available.

HARDWARE AND SOFTWARE:
- Computer: MicroVAX with VMS.
- Storage: Very small.
- Peripherals: 1 printer and VT-100 terminal.
- Language: FORTRAN.
- Documentation: 3-volume set.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Not yet done.

CPU time per Cycle: Runs instantly.

Data Output Analysis: Embedded in program.

Frequency of Use: Used in initial stages of procurement.

Users: USCG Office of R&D.

Comments: PATROL is an easy-to-understand yet comprehensive model of a single vessel on patrol. The effect of each one upon mission performance can be more clearly understood when the inputs are separated into different categories. Policy, strategy, and tactics are expressed in the model through items such as the refueling level, boarding criteria, and search pattern.

TITLE: PAWS - Parametric Assessment of Weapons Systems.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: The BDM Corporation, 7915 Jones Branch Dr., McLean, VA 22102-3396.

POINT OF CONTACT: Earl Williamson, (703) 848-6111.

PURPOSE: PAWS provides a rapid capability to determine how major weapon system parameters influence the expected outcome of a many-on-many direct fire engagement within a detailed tactical and terrain context. It can be used by analytic personnel with only cursory training on an IBM PC-type computer. It is primarily oriented toward weapon system effectiveness, although terrain and tactics are treated.

DESCRIPTION:
Domain: Close combat.

Span: A single engagement between combined arms maneuver units.

Environment: Terrain treated in 500-meter blocks with several categories of forestation, terrain cover, and canalization. Time in increments chosen by the user. Terrain area is 6 km by 3 km.

Force Composition: Combined arms team with artillery fire support.

Scope of Conflict: All conventional direct fire weapons, several categories of artillery, mines, and barriers are played.

Mission Area: Close combat.

Level of Detail of Processes and Entities: The simulation plays a defending force that can be separated into several spatial groupings. As the assaulting force closes on the defending force, the ability of each weapon system to cause attrition changes as the ranges change and the aspect angle of the firer target line changes. Allocation of fire is constantly re-evaluated on the basis of a dynamically changing target value and the opportunities presented by targets. A system (vehicle or fire team) can have several weapons. Each element (part of the attacking force) has several systems.

CONSTRUCTION:
Human Participation: The analyst loads the conditions and objectives of each force, and then executes a trial of the engagement without further input.

Time Processing: Time-step in increments where the minimum time-step is the cycle rate of the weapons.

Treatment of Randomness: Completely deterministic.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: Current version does not integrate long time-of-flight weapons survival (i.e., TOW, Dragon) over the time-of-flight interval.

PLANNED IMPROVEMENTS AND MODIFICATIONS: To integrate survival of long time-of-flight weapons over time-of-flight interval.

INPUT: The probability of hit of each weapon by range and target exposure, the probability of kill of each weapon by aspect angle and exposure, the terrain, the firing doctrine for RED and BLUE, and the tactical objectives of RED and BLUE.

OUTPUT: Killer-victim scoreboards for each weapon versus target combination and the outcome of the engagement. Suppressions and the strength of each element of the force are provided at each time-step.

HARDWARE AND SOFTWARE:

Computer:	Any IBM PC compatible with 512 K RAM.
Storage:	5 1/4-inch floppy.
Peripherals:	Monitor required to run model; printer optional.
Language:	Turbo Pascal.
Documentation:	Current version does not have a user's manual. The input processor is menu-based and very user friendly.

SECURITY CLASSIFICATION: Model data may be classified.

GENERAL DATA:

Data Base: The entire data base can be prepared in several hours if weapons performance data is readily available.

CPU time per Cycle: A cycle can be run in 5 minutes, and modest data changes can be made in 10-20 minutes. Consequently, a series of parametric runs can easily be made in one afternoon.

Data Output Analysis: See output.

Frequency of Use: Not yet established.

Users: BDM, Armor Family of Vehicles Task Force.

Comments: This model is derived from the combat subroutine in CORBAN and the COTES software at BDM Fort Leavenworth.

TITLE: PCFTR - Phase Coded Filter Transfer Response.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze filter response to ECM.

DESCRIPTION: The model was created using the Continuous Systems Modeling Program. It consists of a set of data records which describe the model as connected analog blocks (integrators, summers, gains, etc.). Some blocks are modeled directly with user supplied FORTRAN subroutines. The model simulates the target geometry, radar receiver antenna patterns, target echo and ecm signals, IF channels (including filters) and antenna az & el servos.

INPUT: Filter characteristic data, amplitude and phase measurements, ECM signal parameters (frequency, pulse width, etc.).

OUTPUT: Plots of filter and signals in frequency and time domains.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780-782. Requires array processor.
- Storage: 100K Bytes of 8 Bits; memory requirements: 2M Bytes of 8 Bits.
- Language: FORTRAN IV PLUS.
- Documentation: None.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is Secret.

GENERAL DATA:
- Data Base: Typical data preparation is 3 hours.
- CPU time per Cycle: 2 minutes.
- Comments: Status of Model - completed, debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: PC-TAFSM - Target Acquisition Fire Support Model-PC Version.

DATE IMPLEMENTED: February 1990.

MODEL TYPE: Analytical.

PROPONENT: U.S. Army Operational Evaluation Command/BDM International, Inc.

POINT OF CONTACT: OEC: Mr. Hank Romberg, (703) 756-2392; Fire Support Directorate.

BDM: Dr. Ernie Montayne, (703) 848-5818; Mr. Alan Davis, (703) 848-6614.

PURPOSE: PC-TAFSM is a research and evaluation tool which measures weapons systems effectiveness. It is an event-stepped, force-on-force stochastic simulation which analyzes the capabilities of various fire support weapons systems.

DESCRIPTION:
Domain: Army elements of Air-Land Battle. This includes ground elements and aerial target acquisition assets.

Span: Model flexibility allows a level of detail ranging from corps to platoon. Normally the model represents a blue division facing a red combined arms army.

Environment: Military grid reference system. The model represents day/night combat intensity, movement conditions, and battlefield geometry.

Force Composition: Two-sided force-on-force. PC-TAFSM can represent forces ranging from platoon to corps.

Scope of Conflict: Conventional warfare, mid to high intensity conflict.

Mission Area: Target Acquisition and Fire Support.

Level of Detail of Processes and Entities: Entities: Virtually any type of target acquisition asset can be represented. Maneuver weapons systems are represented as target systems. Each fire support weapon is represented explicitly. Varied types of ammunition may be used. Processes: PC-TAFSM represents the firing and effects of each round of ammunition. Target acquisition is conducted for the full range of assets, from the forward observer to Joint Surveillance Target Attack Radar System (Joint STARS). The model represents unit movement for tactical and survivability moves. The command, control, and communications processes are represented explicitly. Requests for fire from target acquisition assets are placed in queues at operations centers. Ammunition selection and assignment of fire unit missions are according to user input tactics and doctrine. Equipment failure is also represented.

CONSTRUCTION:
Human Participation: Users develop the scenario and provide input in tabular form for the maneuver scenario, target acquisition assets, C3 structure, weapon and ammunition data, and munitions effect parameters.

Time Processing: Dynamic event stepped model. User may input the total simulation time.

Treatment of Randomness: Unit movement and scheduled fires, and some acquisition assets are deterministically scheduled according to a script provided by the user. Monte Carlo determinations are made for acquisitions of targets, communications, reliability of ammunition at impact, and equipment availability at the start of the simulation. Ammunition effects (P_k) are determined for conventional, laser guided, improved conventional, and smart munitions. Stochastic representations include munitions accuracy (bivariate normal), communications times (log normal), equipment down time (log normal), FDC processing time (log normal).

Sidedness: Two-sided force-on-force model.

LIMITATIONS: Terrain is modeled as a grid reference only. Variations in terrain which would limit the visibility of observers are represented by varying the probabilities of acquiring targets.

Tactical moves occur according to scripted input.

The Forward line of troops (FLOT) is represented as a straight line.

Queues in FDCs have no size limit.

The model represents converged sheafs only. Irregular targets must be represented as multiple targets.

PLANNED IMPROVEMENTS AND MODIFICATION: Interactive graphics for modification of scenarios "on-the-fly." Applications for assessing survivability of ground elements for various equipments.

INPUT:

Target Acquisition Assets.
Fire Support Weapons.
Ammunition.
C3 Systems.
Maneuver Units.
Tactical Movement.
EW Parameters.
Attrition Rates.
Scheduled Fires.

OUTPUT:

Killer/Victim Scoreboard.
Rounds Fired by Type by Fire Unit.
Weapon Availability.
Equipment Availability.
Total Mission Time by Type Sensor.
Targets Acquired/Reported/Processed/Engaged.

HARDWARE AND SOFTWARE:

Computer:	PC 286 or 386 based.
Storage:	4 megabytes storage; 2 megabytes RAM.
Peripherals:	Printer.
Language:	SIMSCRIPT II.5.
Documentation:	System Design, Users and Programmers Manuals, Three Day Training Program, Analysis Plan.

SECURITY CLASSIFICATION: Unclassified, data bases may be classified.

GENERAL DATA:

Data Base: Initial data collection takes approximately two man-months. Excursions can be designed in a few days.

CPU time per Cycle: A 386 based PC requires 2-4 hours for a 24-hour simulation.

Data Output Analysis: Output is in formatted DOS text files which can be printed or used as input for statistical software.

Frequency of Use: 15-20 excursions during pre-test or post-test analysis. 5-10 for training purposes.

Users: U.S. Army OPTEC, U.S. Army Field Artillery Center.

Comments: Study Advisory Group consisting of representatives from OPTEC, USAFACS, AMSAA, MICOM, TACOM, AMC, CAA, and DOT&E contributed to model development.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: PD - Passive Detection Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Warfare Center, Studies and Analysis Directorate, San Antonio, TX 78243-5000.

POINT OF CONTACT: AFEWC/SAV, Building 2000, Kelly AFB, San Antonio, TX 78243. DSN: 969-2706, Comm: (512) 977-2706.

PURPOSE: PD predicts whether networks (EOB) of stationary passive detection sites can passively detect and locate targets in the presence of jamming. For each PD site in the EOB, PD calculates the power received by each site and compares the received power levels against the receiver sensitivities for all sites in a network to predict target collection/location capability.

DESCRIPTION:
Domain: Land, air, and sea.

Span: Global (Depending on the location of the order of battle whether it is electronic, air, naval, or army).

Environment: Uses Defense Mapping Agency (DMA) terrain data and World Data Base II country and political boundaries.

Force Composition: Joint and combined forces, Blue, Red, Grey (entire data base can be modified).

Scope of Conflict: Primarily conventional warfare.

Mission Area: Electronic Combat.

Level of Detail of Processes and Entities: Entities: PD can model an entire passive detection order of battle (hundreds of sites) or just a single site. Processes: It incorporates scenario geometries; site locations; Defense Mapping Agency (DMA) terrain; and transmitter and receiver beam dimensions, ERPs, sensitivities, and frequency ranges. The user can add, move, delete, or change the parameters of sites. Signal collection/location range can be displayed for one or a combination of PD networks and can include effects due to stand-off jamming effects on the PD sites.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Static.

Treatment of Randomness: All calculations are deterministic.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Graphics require Tektronix (PLOT10) terminal. All sites with the same id must use the same parametric data. Signal propagation considerations are limited to diffraction, refraction, and absorption in the 20 - 20,000 MHz frequency range. Receiver signal processing is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modifications will be made based on user input.

INPUT: Terrain, passive detection parameter files and site locations, target transmitter power parameters and routes.

OUTPUT: Graphic screen dumps show detection/location ranges, site symbols, geographic boundaries, text and various user aids. Text summary files are produced for further numeric analysis.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	25 Megabytes plus terrain.
Peripherals:	1 or more Tektronix terminals, Tek 4693 or 4694 printer, standard text printer.
Language:	FORTRAN, PLOT10 (Graphics), DCL.
Documentation:	User and Programmer manuals available.

SECURITY CLASSIFICATION: Unclassified - source code. Classified - various data bases and data files.

GENERAL DATA:

Data Base: Dependent upon method of entering OB data base: manual--minutes per site, or automated--sites per minute.

CPU time per Cycle: Dependent on OB data base size, CPU power, and user needs.

Data Output Analysis:

Frequency of Use: Used weekly for AFEWC analyses.

Users AFEWC, SAC.

Comments: N/A.

TITLE: Physical Terrain Board Simulator.

DATE IMPLEMENTED: 1982.

MODEL TYPE: A physical terrain board is used to simulate IR scenes for automatic target recognizer (ATR) performance evaluation.

PROPONENT: Night Vision Lab.

POINT OF CONTACT: Carl Hoover, DSN 354-2730; Comm (703) 664-2730.

PURPOSE: The physical terrain board is used to evaluate ATR and autocuer performance.

DESCRIPTION:

Domain: Ground to ground and air to ground with small depression angles.

Span: Simulates 8-12 micron region. Simulates desert, forest, and rural scenarios.

Environment: Physical terrain board with scale of 400 to 1.

Force Composition: Any combination of red and blue chosen by user.

Scope of Conflict: Thermal signatures of all conventional land based weapons are simulated.

Mission Area: Ground to ground or air to ground with small depression angles.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:

Human Participation: Humans control location of targets and sensors. Data acquired with the TV camera can be fed to an autocuer and tests done to assess effectiveness of autocuer-human system.

Time Processing: N/A.

Treatment of Randomness: Targets are deployed in tactical arrays. There is little randomness in the simulation.

LIMITATIONS: Fixed playing area. No target motion. No sensor motion. No validated simulation or obscurants, such as smoke, fogs, rain or snow. Little multi-sensor capability and no capability to simulate mm wave radar.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A refurbishment of physical terrain board is planned. Development of an electronic terrain board is underway.

INPUT: A physical model of targets and terrain.

OUTPUT: RS 170 or RS 343 analog video output which simulates an IR signature in the 8-12 micron band.

HARDWARE AND SOFTWARE:

Computer(OS): Analog imagery is digitized and manipulated with SUN workstation which use a UNIX operating system.

Storage: Training sets are available on 8mm tape. The tape hold 25 Gbytes of data. Each image requires 0.25 Mbytes.

Peripherals: No additional peripherals are needed.

Language: C or C++.

Documentation: Documentation of test methodology, file formats and image formats are available.

SECURITY CLASSIFICATION: Unclassified.

TITLE: PIVADS - Product Improved Vulcan Air Defense System Effectiveness Model.

DATE IMPLEMENTED: 6 August 1991.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Ballistic Research Laboratory (USABRL), Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: Dr. Joseph K. Wald, AV 298-9077.

PURPOSE: The PIVADS Effectiveness Model simulates the effectiveness of the PIVADS in an engagement against a fixed- or rotary-wing aircraft executing an arbitrary flight profile.

DESCRIPTION:

Domain: Land and air.

Span: One-on-one engagement.

Environment: Clear day operations in flat terrain.

Force Composition: One PIVADS versus one helicopter or fixed-wing aircraft.

Scope of Conflict: Exclusively conventional.

Mission Area: Air defense.

Level of Detail of Processes and Entities: Individual weapon systems are modeled. PIVADS target tracking errors and fire control are modeled continuously, with bullet flyout and target damage calculations for each bullet

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Time-step model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness One-sided; the aircraft does not react to the PIVADS.

LIMITATIONS: Simulation is one-sided.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Ammunition characteristics, fire doctrine and burst policy, aircraft flight profile, aircraft vulnerability data.

OUTPUT: Engagement statistics, including kill probabilities and delivery errors.

HARDWARE AND SOFTWARE:

Computer:	Cray 2/UNIX.
Storage:	Approximately 125,000 bytes necessary at run time.
Peripherals:	1 terminal, 1 line printer.
Language:	FORTRAN.
Documentation:	BRL report: Product Improved Vulcan Air Defense System Effectiveness Model User Manual.

SECURITY CLASSIFICATION: Confidential.

GENERAL DATA:

Data Base: No formal data base required.

CPU time per Cycle: Typically 10 seconds per Monte Carlo replication.

Data Output Analysis: No postprocessing required.

Frequency of Use: Model completed and validated August 1988.

Users: U.S. Army Ballistic Research Laboratory (USABRL) and U.S. Army Materiel Systems Analysis Activity (USAMSAA).

Comments: Model structure is similar to that of the Modern Gun Effectiveness Model (MGEM).

TITLE: PLLM - Path-Loss Line-of-Sight Model.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: The PLLM model is a research and evaluation tool that generates map overlays and plot tapes depicting path-loss related calculations (power density, field strength, received signal, etc.) and/or terrain shielding calculations relative to a specified site. If the path-loss mode is selected, up to 6 independent path-loss values may be calculated per run. If the terrain shielding mode is selected, up to 5 independent shielding quantities may be calculated per run by entering 5 site antenna heights. If both the path-loss and the terrain shielding modes are selected, a minimum of 5 quantities may be calculated per run.

DESCRIPTION:
Domain: Primarily land area - can use terrain data.

Span: Used for areas 200 square nm or less.

Environment: Terrain relief.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Communications coverage.

Level of Detail of Processes and Entities: Individual transmitter.

CONSTRUCTION:
Human Participation: Not required and not permitted.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Not useful for areas greater than 200 square nm.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None planned.

INPUT: Transmitter, receiver locations, and the Defense Mapping Agency's Digital Terrain Elevation Data (DTED).

OUTPUT: Computer printouts and contour plots.

HARDWARE AND SOFTWARE:
Computer: UNISYS/EXEC, VAX using VMS and SUN Workstation using UNIX.
Storage: 2 MB.
Peripherals: Tektronix, Calcomp Plotter, Line Printer.
Language: FORTRAN.
Documentation: Theory manual and user's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One hour or less.

CPU time per Cycle: 5 minutes to 2 hours - depends on level of terrain data.

Data Output Analysis: Requires understanding of power levels.

Frequency of Use: Daily in general.

Users: ECAC, JEWC, others.

Comments: Developed at ECAC for in-house analyses and then ported for other users.

TITLE: PLRS/EPLRS Deployment Aids - Connectivity Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis (but can be used for training).

PROPONENT: Vulnerability Assessment Laboratory, C3I Vulnerability Assessment Division, SLCVA-CE Bldg. 2525, Ft. Monmouth, NJ 07703.

POINT OF CONTACT: Mr. Anthony L. Barnes, (201) 544-4166, AV 995-4166.

PURPOSE: The deployment aids model is used to select the number and position of dedicated PLRS or EPLRS relays, and the location of the MS.

DESCRIPTION:
Domain: Land and air.

Span: Accommodates any theater depending on terrain data base.

Environment: Terrain-based.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Electronic warfare.

Mission Area: Communications, data links.

Level of Detail of Processes and Entities: Individual nodes of the network.

CONSTRUCTION:
Human Participation: User provides the model with the deployment parameters and controls the decision-making process.

Time Processing: Static.

Treatment of Randomness: Path loss deterministically based on connectivity model.

Sidedness: One-sided.

LIMITATIONS: Homogeneous propagation environment, static deployment of elements, uniform statistical distribution of units, PLRS units, and line threat (not point jammers).

PLANNED IMPROVEMENTS AND MODIFICATIONS: A graphics interface to the model is being developed.

INPUT: User provides the deployment parameters.

OUTPUT: Plot of MS, relays, footprints.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	14,000 blocks (7 MB).
Peripherals:	One printer and one plotter.
Language:	FORTRAN.
Documentation:	Users manual and reference manual.

SECURITY CLASSIFICATION: Unclassified, but terrain data base may be classified.

GENERAL DATA:

Data Base: Terrain data bases available from DMA.

CPU time per Cycle: Depends on configuration. Approximately one hour.

Data Output Analysis: Produces hardcopies of data and plots.

Frequency of Use: Varies.

Users: LABCOM, CECOM.

Comments: The deployment aids model is linked to the connectivity model.

TITLE: POL - Petroleum, Oil, Lubricants.

DATE IMPLEMENTED: April 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276.

PURPOSE: POL models intratheater commodities consumption and distribution patterns. It provides logistic data in support of larger-scale war games.

DESCRIPTION:
Domain: Sea.

Span: Intratheater.

Environment: N/A.

Force Composition: Combatant and replenishment ships, forward bases.

Scope of Conflict: N/A.

Mission Area: Logistics.

Level of Detail of Processes and Entities: POL is concerned with the segment of commodities movement that originates at advanced bases and terminates with delivery to operating forces. The user inputs initial commodities types and quantities, locations of advanced bases, compositions and locations of task groups, and locations and loading of replenishment ships.

CONSTRUCTION:
Human Participation: Initial data base inputs and iterative time-step specification.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: POL assumes optimal weather conditions and replenishment equipment and efficiency. User may modify task group consumption rates to simulate nonoptimal conditions. Input-intensive model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Commodities type, quantity, and location; task group composition by ship type, location, and associated resupply port; combatant ship commodity consumption rate; replenishment ship load time, capacity, start load, speed, and assigned task group; port load factor, capacity, location, and inventory; time-step; and movement of task groups may be specified at each time-step.

OUTPUT: Results written to output file. Output consists of detailed summary of task group, replenishment ship, and port status, including commodities status and unit location. Output can be for start and final time-step only or for each time-step.

HARDWARE AND SOFTWARE:

Computer: Dual disk drive IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: N/A.
Language: FORTRAN.
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One hour.

CPU time per Cycle: N/A.

Data Output Analysis: Detailed summary of current status at end of time-step.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: POL is based on algorithms presented by CAPT. J.A. Peschka, USN, in "POL Support to Battle Forces in the Maritime Strategy," NWC 53-86. At NWC, it is used for logistical inputs into larger-scale war games. POL may also be useful for analytical study.

TITLE: POO1A - Anti-Aircraft Artillery Simulation Computer Program.

DATE IMPLEMENTED: December 1985.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: POO1A computes the single-shot probability-of-kill of a target aircraft flying through AAA. The results are used in weapon systems effectiveness studies.

DESCRIPTION:
Domain: Air and land.

Span: Individual aircraft against individual AAA site.

Environment: Terrain relief.

Force Composition: Individual elements.

Scope of Conflict: Conventional.

Mission Area: Tactical.

Level of Detail of Processes and Entities: Entity: Aircraft AAA site. Processes: Movement of aircraft.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: POO1A does not simulate AAA system radar or ECM.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: POO1A inputs include flight paths, ground weapon location and performance parameters, and aircraft vulnerable area.

OUTPUT: The model produces single shot probability of kill and aircraft sector vulnerability data.

HARDWARE AND SOFTWARE:
Computer: VAX, PC-Compatible, IBM 3081.
Storage: 110 KB.
Peripherals: N/A.
Language: FORTRAN V.
Documentation: POO1 User's Manual, POO1 Analyst Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: POPP - Pulse Doppler Operational Performance Program.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Warfare Center, Studies and Analysis Directorate, San Antonio, TX 78243-5000.

POINT OF CONTACT: AFEWC/SAV, Building 2000, Kelly AFB, San Antonio, TX 78243. DSN: 969-2706; Commercial: (512) 977-2706.

PURPOSE: POPP predicts the vulnerability of the AWACS APY-1/2 radar to (a maximum of) 10 jammers using actual antenna patterns.

DESCRIPTION:

Domain: Air.

Span: Individual.

Environment: Free space.

Force Composition: Single AWACS versus multiple jammers.

Scope of Conflict: Primarily conventional warfare.

Mission Area: Electronic Combat.

Level of Detail of Processes and Entities: Entities: POPP models a single AWACS APY-1/2 radar against multiple jammers. Processes: It incorporates jammer and receiver beam ERPs, sensitivities, and frequency ranges.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Static.

Treatment of Randomness: All calculations are deterministic.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Graphics require Tektronix (PLOT10) terminal. POPP does not have the capability to perform clutter analysis. Jammer signal propagation modeling is limited to free space considerations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modifications will be made based on user input.

INPUT: Radar parameter files and jammer power parameters.

OUTPUT: Graphic screen dumps show jamming degradation to the radar in azimuth.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	500 kBytes.
Peripherals:	1 or more Tektronix terminals, Tek 4693 or 4694 printer.
Language:	FORTRAN, PLOT10 (Graphics), DCL.
Documentation:	User manual available.

SECURITY CLASSIFICATION: Unclassified - source code. Classified - various data bases and data files.

GENERAL DATA:

Data Base: Requires minutes to update.

CPU time per Cycle: Less than 5 minutes.

Data Output Analysis:

Frequency of Use: Used weekly for AFEWC analyses.

TITLE: PRISM - Physically Reasonable Infrared Signature Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Tank Automotive Command (TACOM), Michigan.

WORKED SPONSORED BY: CECOM Center for Night Vision and Electro-Optics
Attn: AMSEL-RD-NV-VMD-TST, Ft. Belvoir, VA 22060-5677.

POINT OF CONTACT: Michael D. Lander, DSN 354-4074, Comm (703) 664-4074.

PURPOSE: To predict thermal signatures of military vehicles (primarily ground vehicles). It is specifically designed to utilize Ballistic Research Laboratory (BRL) target files that have been converted into a faceted format. C2NVEO uses PRISM in its three dimensional synthetic scene generation.

DESCRIPTION:

Domain: Ground vehicles.

Span: Accommodates several different spectral bands (e.g., 3-5 and 8-12 micron) for its predictions. It is able to use weather data from various geographical areas.

Environment: Code is developed for specific machines (e.g., there is a Silicon Graphics version as well as a SUN version). Models diurnal cycles of vehicles.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Three-Dimensional synthetic thermal scene modeling.

Level of Detail of Processes and Entities: A. Target File Construction: Precise composition and orientation of vehicle facet construction is required to accurately thermally model a vehicle. B. Execution of PRISM Model: Setup for execution of PRISM requires accurate and detailed meteorological information. Scenario descriptions must be known to provide information concerning latitude and longitude of test site, and aspect of target.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic, time- and event-stepped model. Progresses through set number of diurnal cycle intervals that have been user defined.

Treatment of Randomness: PRISM is basically a deterministic model.

Sidedness: N/A.

LIMITATIONS: Target file construction requires extensive knowledge of target configuration.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None are planned.

INPUT: Target files, meteorological files.

OUTPUT: Tabular thermal file of predictions is created.

HARDWARE AND SOFTWARE:

Computer(OS): Silicon Graphics IRIS 4D GTX parallel processing graphics workstation. UNIX based operating system.
Storage: Hard disk required (approximately 80 Mbytes).
Peripherals: Laser Printer.
Language: Believed to be FORTRAN 77.
Documentation: Available from TACOM.

SECURITY CLASSIFICATION: Unclassified, but restricted distribution to licensees for the source code of PRISM. Target files utilized by PRISM may be classified, and are available on a limited basis.

GENERAL DATA:

Data Base: 16 hours.

CPU time per Cycle: Depends on the complexity of the target and the length of the thermal cycle duration.

Data output Analysis: Thermal file of predictions created. Output is viewable using FRED (Facetized Region Editor) by TACOM. Mean and standard deviation are reported.

TITLE: PROLOGUE - Planning Resources of Logistics Units Evaluator.

DATE IMPLEMENTED: January 1985.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Logistics Evaluation Agency (USALEA), New Cumberland, PA 17070-5007.

POINT OF CONTACT: James A. Cohick, LOEA-PL, (717) 770-6744, AV 977-6744.

PURPOSE: PROLOGUE is used to evaluate the logistics aspects of operation plans time-phased at the theater, echelon above corps, corps, and offshore base levels. It is specifically designed to serve as both an operations support and force capability tool to determine logistics units (maintenance, supply, and transportation) capabilities to perform wartime missions. PROLOGUE has also been used extensively to assist theater logistics planners to develop operation plan forces.

DESCRIPTION:

Domain: Land logistics support operations, intratheater.

Span: Global, theater, regional, or individual divisional force, depending on the time-phased force composition.

Environment: N/A.

Force Composition: U.S. Army time-phased force deployment units and the time-phased deployment nonunit data the Army supports.

Scope of Conflict: Conventional warfare.

Mission Area: Army maintenance of unit equipment and supply handling and transportation lift of supply and resupply of materiel.

Level of Detail of Processes and Entities: Maintenance units are evaluated as to their capabilities to complete direct and general support levels of maintenance. Supply units are evaluated as to their capabilities to handle war reserves and supply and resupply tonnages of materiel. Transportation units are evaluated as to their capabilities to lift local and line haul requirements.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic, time-step, relative to the time phasing of the force being evaluated.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Limited to the evaluation of logistics units on a time-phased force deployment list.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Include the following capabilities files: TDA/MOBTDA units, wartime host nation support resources, and interservice support agreements.

INPUT: Operation plan time-phased deployment force data, current unit equipment and personnel data, maintenance man-hours for unit equipment, and geolocation data for locations in a theater.

OUTPUT: Computer printouts, raw data files, statistically analyzed data for wartime maintenance, and supply and transportation functions within a theater of operations.

HARDWARE AND SOFTWARE:
- Computer: UNIVAC 1100-71.
- Storage: N/A.
- Peripherals: Printer and terminals.
- Language: COBOL.
- Documentation: Local user manuals for modules.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: 1 hour to 80 hours depending on the application.

Data Output Analysis: Detailed and summarized analyses.

Frequency of Use: Used continuously at USALEA to support its own missions. PROLOGUE is being installed at HQWESTCOM and will eventually be made available for export to other MACOMs.

Users: USALEA, HDQA ODCSLOG, and MACOMs.

Comments: USALEA has initiated action to include PROLOGUE for easy access and use by theater Army logistics planners.

TITLE: PYRO - Pyrophoric Flare Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The PYRO model describes the combustion of pyrophoric flare fuel in the wake behind a falling flare. The model determines the ignition and continuous burn of the flare.

DESCRIPTION: PYRO is essentially a combination of previously developed models. The fluid mechanical structure of the code was largely taken from the Low Altitude Plume Program (LAPP). The radiation calculations of the model were done with the Standard Infrared Radiation Model (SIRRM). SIRRM was developed to calculate the source apparent signature of a tactical and strategic missile plume. The code in each module was modified to represent pyrophoric flare plume instead of a rocket plume. The computations of the model are done in three programs linked together. These programs are 1) PYRO, the controller for the stirred reactor near-wake subroutine (LAPSR) and the far-wake subroutine (LAPP), 2) PLUM252, the interface module which interfaces PYRO with SIRRM, and 3) SIRRM, the radiation model.

INPUT: The Pyrophoric Flare Model has nine input sets. They are as follows:

- Band Model Input.
- Conversion Input.
- Namelist Input.
- Non-Standard User Specified Input.
- Optical Properties Input.
- Pyro Input.
- Standard Atmosphere Input.
- Transmission Input.
- LOWTRAN Input.

Each of the input sets is described in detail, containing variable names, formats, and variable descriptions in the Pyrophoric Flare Model Documentation Part II - User's Guide.

OUTPUT: PYRO provides some form of output for each phase of the simulation. The three main types are printed output, intermediate files on magnetic disk or tape, and plots.

Phase I - Near-Wake Stirred Reactor:

The following output is printed by the LAPSR (stirred reactor) program in the first phase of PYRO:

- Identification containing the run title, the inputs to the stirred reactor, and the reactions used.

- A step summary for the stirred reactor. PT 1 is the reactor, PT 2 is air at the stagnation conditions, and PT 3 is air at free-stream conditions.

- A momentum, species, and enthalpy check. Momentum and species should remain nearly 1.0; the enthalpy is in Btu/lb.

- Initial particle (droplet) properties, including the initial particle size distribution.

NPZ = number of zones.
NPC = number of droplet sizes.
RHOL = fuel density, lb/cubic ft.
SCF = drop Schmidt Number.
PFV = drop Prandtl Number.
XMTMA = mole fraction of TMA.
TEMP = temperature, K.
VELP = velocity, ft/sec.

- The reactor temperature is shown every ten integration steps. X is the integration variable. A successful run is indicated by a relatively steady temperature. The time limit to converge the stirred reactor can be changed in the input file to optimize the number of steps.

- A final step summary for the reactor.

- A final momentum, species, and enthalpy check.

- Final particle sizes (microns) and temperature (K).

<u>Phase II - Far-Wake Mixing Calculation</u>:

The following output is printed by LAPP in the second phase of PYRO:

- Identification including title and input summary for the calculation.

- A step summary. For the far-wake calculation, PT1 to PTn represent radial positions.

- A momentum, species, enthalpy check. Momentum and species should remain nearly 1.0; the enthalpy, in Btu/lb, should remain nearly constant.

- Droplet summary. Zone 1 corresponds to PT1, Zone 2 to PT2, etc.

- Steps 2, 3, and 4, above are repeated for each axial station summarized. Note that the second axial station summarized gives the results of smoothing the input data before chemistry is applied.

- When a particle class evaporates during the calculation, the axial location is printed.

- When the radial zones are combined to increase the grid spacing, the resultant drop mass XM, in moles/gm of gas, in each size group is printed for each new zone.

During the far-wake calculation program, LAPP generates a file of flow field data on Unit 1, which is read by the PYRO conversion interface program.

<u>Phase III - Conversion Interface</u>:

This phase converts the output flow field created by LAPP into a data file format usable by SIRRM.

<u>Phase IV - SIRRM - Printed Output</u>:

The printed output generated by the SIRRM program written to FORTRAN I/O unit 6 can be divided into four basic types of data:

- Warning and error messages,
- Echo of input data,
- Atmospheric and plume layer information, and

- Warning and error messages,
- Echo of input data,
- Atmospheric and plume layer information, and
- Calculated radiation output.

The warning and error messages are discussed in the section on Troubleshooting. The following output is printed by SIRRM in a successful execution of the model:

- Identification including title, run identification, and input summary.
- A dictionary of abbreviations used for column headings.
- Atmospheric composition consisting of data for layers and gaseous concentrations.
- Spectral radiant intensity at each wavenumber.
- Response at each wavenumber.
- A summary of intensity data.

<u>HARDWARE AND SOFTWARE</u>:

<u>Computer</u>: VAX 11/780.

<u>Language</u>: FORTRAN.

<u>Documentation</u>: Part I Management Summary (classified). Part II User's Guide (unclassified). Part III Programmer's Manual (unclassified). Part IV Analyst's Manual (unclassified).

<u>SECURITY CLASSIFICATION</u>: Source Code is unclassified.

<u>GENERAL DATA</u>:

<u>Time Requirements</u>: Compilation time: 252 seconds (with linking); Typical run time: 9.5 minutes.

<u>Users</u>: SAIC.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: QJM - The Quantified Judgment Model.

DATE IMPLEMENTED: 1979; Present Version 1989.

MODEL TYPE: Analysis, but has been used/described for training support at CGSC, NDU, and USMA.

PROPONENT: Data Memory Systems, Inc., Historical Evaluation & Research Organization, 10392 Democracy Lane, Fairfax, VA 22030, (703) 591-3674, FAX (703) 591-6109.

POINT OF CONTACT: Maj. C.F. Hawkins, USAR (Ret).

PURPOSE: The QJM is an analytical and operation support tool used to model force-on-force combat engagements, primarily at the division level, but is also used effectively at levels of aggregation from battalion through corps.

DESCRIPTION:
Domain: AirLand Battle.

Span: Sector; accommodates theater scenarios by dealing with sectors successively.

Environment: Day and night operations, all seasons, four climates, 18 terrain/vegetation choices, 12 weather choices, road net, and water barriers.

Force Composition: Joint and combined forces, BLUE and RED, may be entered manually, or prestored in a forces data base, uses measures of effectiveness based on weapon's lethality to derive combat power.

Scope of Conflict: Conventional warfare; combat aspects of low intensity warfare and contingency operations.

Mission Area: All conventional ground force AirLand Battle missions; air missions limited to close air support; naval missions limited to naval gunfire support of amphibious force.

Level of Detail of Processes and Entities: Provides WINNER/LOSER, advance rate, personnel attrition by type, equipment attrition by type, and attrition of close air support aircraft by type.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Engagements may be from one hour to five days at the discretion of the analyst. After data base set up, results can be provided in less than five minutes.

Treatment of Randomness: Deterministic, outputs are derived empirically (historical analysis); at the discretion of the analyst, any method may be used to treat random variables.

Sidedness: Two-sided, symmetric; can be operated by a single analyst.

LIMITATIONS: Does not model air or naval warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved representation of air defense, anti-armor close air support, smart munitions, fuel air explosives, technological factors. Modifications planned for nuclear, biological, and chemical effects, and combat service support (logistics).

INPUT: RED and BLUE orders of battle data based on weapons scoring system (Operational Lethality Index). Selection of 19 analytical factors including terrain, weather, defensive posture, surprise, air superiority, fatigue, and combat effectiveness.

OUTPUT: WINNER/LOSER, advance rate, attrition (personnel and equipment), analysis of the effect of various factors on weapons and personnel.

HARDWARE AND SOFTWARE:

Computer:	IBM PC or compatible; (Software: Copyright by Data Memory Systems, Inc.).
Storage:	Hard disk recommended; executable code is less than one megabyte, forces data base is normally less than one megabyte.
Peripherals:	Printer.
Language:	Turbo Pascal.
Documentation:	Source code and comments provided, users manual fully describes methodology and software use, three-volume data base of historic combat engagements provided.

SECURITY CLASSIFICATION: Source Code is unclassified. Forces data are often classified.

GENERAL DATA:

Data Base: Weapon's scores for RED and BLUE forces, organized into six classes of weapons, six vehicle classes, and numbers of troops, weapons, and equipment.

CPU time per Cycle: Calculations results in five to ten seconds, throughput in under five minutes.

Data Output Analysis: Time to print, under one minute.

Frequency of Use: N/A.

Users: Boeing Aerospace, LTV Corp., Joint Warfare Center, SHAPE Technical Centre, USAREUR HQ, PACOM HQ, FORSCOM HQ, NU, DTA, Mitsubishi Space Software Co., Ltd., OSD/Net Assessment, Sandia National Laboratory.

Comments: The QJM places as much emphasis on human factors affecting combat outcomes as it does on technological or material factors. Developed and tested on data from more than 200 historical combat engagements from 1915 through 1990, the QJM is one of the few force-on-force combat simulations that can claim historical validity. Simulated combat termination (option item) for either time-step or event-version simulations provided by the Armor Breakpoint Model (ABM) for armored/mechanized forces only. See Armor Breakpoint Model.

TITLE: Radar Workstation.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Technology Service Corporation, P.O. Box 1210, Dahlgren, VA 22448.

POINT OF CONTACT: Kim Simpson, (703) 663-9227.

PURPOSE: The Radar Workstation includes an integrated set of program modules for analyzing the performance of radar systems in clear and adverse environments. Application of the model includes parametric tradeoff analysis, theoretical performance prediction, and training of new radar analysts.

DESCRIPTION:

Domain: Land, air, sea, and space.

Span: N/A.

Environment: Surface or volume clutter, electronic countermeasures.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Models down to the radar component level: antenna, transmitter, signal processor, etc. Models environment in terms of atmospheric losses and propagation paths from radar to target. Considers mean characteristics of surface and volume clutter. Includes flexibility for a wide range of radar waveform types.

CONSTRUCTION:

Human Participation: Required for radar parameter inputs and selection of type of output.

Time Processing: Static for a specific dwell time on the target.

Treatment of Randomness: Processes are by direct computation.

Sidedness: One-sided.

LIMITATIONS: Radar frequency ranges from 100 MHz to 100 GHz.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Menu-driven operation, full-screen editing, input prompting, and help screen. Operator enters relevant radar and environmental parameters.

OUTPUT: High-resolution color graphics or printed results.

HARDWARE AND SOFTWARE:

Computer:	IBM PC, XT, or AT with two disk drives or single disk drive plus hard disk; 8087 math chip processor.
Storage:	640K memory
Peripherals:	RGB color monitor, IBM CGA or EGA graphics adapter, dot matrix printer.
Language:	"C," DOS 2.0 or later, Lotus 1-2-3 Version 2.
Documentation:	User's guide and functional description manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: Government, industry, and consultants.

Comments: Version 2.0 was released in 1988. Version 2.1 will be released in 1989.

TITLE: RADET-E^3 - Radar Detection, ESM, ECM, ECCM Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Electronics and Space Corp. (E&S Corp.), 8100 W. Florissant, St., Louis, MO 63136.

POINT OF CONTACT: Greg Novak, 314-553-4595, (FAX) 314-553-4750.

PURPOSE: RADET-E^3 is a research and evaluation tool used to analyze the offensive and defensive capabilities of a ground or airborne radar system. Offensive capability being defined as the effectiveness of a surveillance radar in detecting a target and the defensive capability being the ability to avoid/delay detection, interception, location and targeting by the opposing force electronic support measure (ESM). It also allows evaluation of the effects of threat electronic countermeasures (ECM) on radar performance and the benefits of potential counter-countermeasures (ECCM). Surveillance capabilities of continuous wave and frequency modulated continuous wave radars are modeled as well as the effects of sidelobe canceling as part of the basic surveillance radar capability.

DESCRIPTION:
Domain: Land, air.

Span: Local, individual radar, individual target.

Environment: No terrain features; weather clutter defined through input.

Force Composition: Individual radar/target combination.

Scope of Conflict: Conventional, with emphasis on electronic battlefield considerations.

Mission Area: Air Defense; Surveillance and Target Acquisition; Electronic Warfare.

Level of Detail of Processes and Entities: High resolution. As a radar functional simulation model, it embodies the basic elements of Radar Range Equations, Target Models (RCS), Propagation Effects, Clutter Models, Detection Models, Tracking Models, Jammer Models.

CONSTRUCTION:
Human Participation: Not required or permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic, expected value.

Sidedness: Two-sided, asymmetric, reactive model.

LIMITATIONS: One radar, one target.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of User Graphics Interface and Bistatic Radar Model.

INPUT: Radar, target, ESM, ECCM and weather specifications.

OUTPUT: Computer printouts and plots.

HARDWARE AND SOFTWARE:
Computer(OS): VAX 11/780 (VMS 5.3) or VAX Station 3100 Model 40 (VMS 5.3).
Storage: 3,500 blocks.
Peripherals: Printer, graphics workstation/terminal.
Language: FORTRAN 77.
Documentation: User's Manual published.

SECURITY CLASSIFICATION: Unclassified; data can be classified.

GENERAL DATA:
Data Base: Hours to man-weeks depending on the number of sensitivities to be evaluated.

CPU time per Cycle: 5-10 minutes.

Data Output Analysis: Hours to man-weeks depending on research issues.

Users: E&S Corp., LABCOM-VAL.

TITLE: RADGUNS - RADar-Directed GUN System Simulation.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Foreign Science & Technology Center/AIFREB, 220 Seventh Street NE, Charlottesville, VA 22901-5396.

POINT OF CONTACT: Mr. Dwight FitzSimons, (804) 980-7838, AV 274-7838.

PURPOSE: RADGUNS is used to evaluate the effectiveness of AAA systems against penetrating aerial targets. It can also evaluate the effectiveness of different airborne target characteristics (cross section, maneuvers, use of electronic countermeasures, etc.) against a specific AAA system.

DESCRIPTION:

Domain: Land, naval, and air.

Span: Individual.

Environment: Limited, simplified clutter and multipath models are implemented. Terrain modeling is limited to a single user-defined hill.

Force Composition: One AAA system versus one penetrating airborne target. RADGUNS models the full AAA system engagement, including search & track radars, optic systems, guns, fire control computer, operators, environment, & target aircraft. Current models include RED 23, 30, 57, 85, & 100 mm; & GRAY 35 & 40 mm AAA (radar or optical-directed) systems against BLUE airborne targets.

Scope of Conflict: Conventional radar or optical-directed.

Mission Area: One-versus-one AAA engagement.

Level of Detail of Processes and Entities. Single AAA system against a single airborne target. Target tracking is based on pulse-by-pulse radar receiver model processing the returns of the target (including multipath & ground clutter). Attrition of airborne target is probability of kill using 6- or 26-view target vulnerable areas. Single-intercept, burst, and cumulative probability of hit & probability of kill calculated.

CONSTRUCTION:

Human Participation: Not required, model not interruptable after input data has been entered.

Time Processing: Dynamic, time-step.

Sidedness: One-sided.

LIMITATIONS: Cannot support one-versus-many or many-on-many encounters. Terrain modeling is limited to analytic terrain models. ECM routines limited to noise, inverse gain, and range-gate walk-off techniques. No reactive maneuvering against a weapon system. Chaff and flares not modeled at this time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional seeker and tracker systems, gun systems, ECM and ECCM capabilities, DMA terrain model, more detailed end-game model.

INPUT: Scenario parameters (for interactive or batch execution) are specified in an input "parameters" file. Data may be written into this parameters file either manually or from a menu-driven "user-input" program.

OUTPUT: Depends on simulation type and user selection. An event-by-event tabular file is generated, as are files for plotting of simulation results. The user can also select generation of a file for 3-dimensional graphics display using the RADPIX plotting program (which calls Plot-10 IGL routines and plots on a Tektronix graphics terminal (or emulator)).

HARDWARE AND SOFTWARE:
- Computer: IBM 3090 (VM-CMS), VAX (VMS & UNIX), & SUN (UNIX).
- Storage: N/A.
- Peripherals: Printer & optional Tektronix graphics terminal.
- Language: FORTRAN 77.
- Documentation: RADGUNS User/Programmer/Analyst Manual.

SECURITY CLASSIFICATION: Code is up to Secret, target data S/NF.

GENERAL DATA:

Data Base: Internally hard-coded in program and in block data files.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: Daily during course of a study.

Users: Approx. 40, incl. USAFSTC, AFCSA/SAGR, NWC, et al.

Comments: JTCG/AS has accepted RADGUNS as its standard AAA model.

TITLE: RAMFIRE - RAM Force Integration & Reactive Engagement.

DATE IMPLEMENTED: Under continuous improvement and configuration management since 1985. Currently Version 17.0 is implemented (August 1991).

MODEL TYPE: Analysis.

PROPONENT: Research Analysis and Maintenance (RAM), Inc., 1790 Lee Trevino Drive, El Paso, TX 79936-4525.

POINT OF CONTACT: Mr. Ron Wood, (915) 592-7047, Ext. 120.

PURPOSE: RAMFIRE is a comprehensive analysis tool capable of addressing several aspects of research and evaluation. It provides a very high resolution simulation of weapon systems and tactics in brigade and below combined arms operations and can deal with:

a. Weapon Systems - Modeled as individual platforms which may be configured with known or postulated weapons, sensors, crews, etc., which interact in accordance with user-defined, decision-table driven system functional processes. All individual systems are data driven, therefore the expert-system architecture and detailed weapon system performance input data structure permit very flexible systems effectiveness analysis.

b. Force Capability and Requirements - Alternative courses of action in force-on-force engagements are supported through the decision table/expert-system processes of the model. Battlefield situations are assessed through the examination of pre-defined conditional variables, and fire and maneuver decisions effected in accordance with user specified inference rules. Because each weapon system/combatant is modeled as an individual entity, the capability for force-mix analysis is extremely powerful.

c. Combat Development - In addition to weapon system processes, command and control functions are exercised via the decision table/expert-system logic, providing the capability to capture the effects of changes in tactics or doctrine and assess the impact on system/force effectiveness.

DESCRIPTION:

Domain: Combined arms ground combat, air support and air defense.

Span: The RAMFIRE model will accommodate a combined arms ground and air force-on-force conflict of a friendly heavy brigade versus a reinforced threat regiment, each with its respective combat and service support elements. Virtually any ground or air weapon system, sensor, command and control methodology, communication function, tactics and doctrine may be simulated subject to availability of terrain and system performance data.

Environment: RAMFIRE uses digitized terrain data in the ARTBASS format to perform studies and evaluate the effects of terrain, vegetation, and man-made features on vehicular mobility, observation, sensor performance, communications, and cover and concealment. Off-line utilities have been developed by RAM to convert Defense Mapping Agency terrain elevation and surface/cultural feature digitized data to ARTBASS format. Either day or night light conditions can be played, however, the light conditions remain constant throughout the duration of the conflict. Smoke, dust, haze and other battlefield obscurants are modeled as dynamic clouds which develop according to prevailing wind conditions. Cloud profiles and movement are generated offline in the Combined Obscuration Model for Battlefield Induced Contaminants

(COMBIC), developed by the Atmospheric Sciences Laboratory, and provided to the model as input data.

Force Composition: The ground forces for both the friendly and threat sides may be simulated at the brigade and regimental level respectively. The forces also include the combat support units, ground and air (fixed wing and helicopters). This level is imposed as a practical limit in order to maintain the high level of resolution and fidelity of the model and reduce computer run time.

Scope of Conflict: All conventional weapon systems found in the division forward battle area may be simulated. Supporting artillery, air defense artillery (SHORAD and HIMAD), unmanned vehicles, fixed wing aircraft, and helicopters may be portrayed in the force structure. RAMFIRE will play limited chemical and nuclear effects if desired. Typically, battle duration is held to one hour or less due to the level and activity of the conflict, which produces a very large volume of output data for analysis.

Mission Area: Both offensive and defensive operations are modeled at the heavy brigade and threat regiment level including ground and air systems. Battle area is a function of digitized terrain data cell resolution (100 Km x 100 Km for 100 meter terrain granularity, 12.5 Km x 12.5 Km at 12.5 meter resolution, etc.).

CONSTRUCTION:
Human Participation: The model is not run-time interactive. User/analyst interaction is effected by preparing decision tables/rules prior to model execution.

Time Processing: The model accommodates time-dependent processes through event-sequencing. Some subprocesses may be modeled as time-step events.

Treatment of Randomness: The model is stochastic, requiring Monte Carlo execution of scenarios. Detection and end-game (probability of hit/kill) are stochastic. Line-of-sight and some weapon system processes (e.g., missile flight dynamics) are deterministic.

Sidedness: The model is two-sided and symmetric. All system processes for each side are executed in the same code modules.

LIMITATIONS: Unit move/maneuver is accomplished in accordance with fixed, pre-planned movement control points (x, y, and z coordinates). Only limited capability exists for alternative pre-planned route selection. Fixed-wing air-to-air engagements are not supported.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Dynamic move/route selection in response to target detection has been implemented for fiber-optic guided missiles. Extension of dynamic movement to other platforms in response to external events other than detection (tactical decisions, receipt of fire, etc.) is feasible for implementation if required. The capability to exercise own-side engagement (fratricide), identification friend or foe (IFF), and noncooperative target recognition (NCTR) is in preliminary design.

INPUT: Input data requirements are extensive. Over one hundred files may be required for large scenario execution. Data file types include:

- Digitized terrain.
- Type unit.
- Unit organization.
- Weapon systems performance.
- Sensors.
- Lethality/vulnerability data.
- Communications nets.
- Decision tables.

OUTPUT: Individual event history files are created which are postprocessed to provide killer-victim scoreboards, unit summaries and/or special input files for statistical analysis and graphic playback.

HARDWARE AND SOFTWARE:

Computer(OS): Digital Equipment Corporation VAX-series computers operating under VMS. An integrated Individual Modeling and Analysis Graphics Experimentation Station (IMAGES), based on the VAX-3000 series workstation, is available which provides automated scenario input support and graphic playback capability.

Storage: Responsive execution through-put requires 16MB RAM (32 MB recommended) and 500 MB of mass storage (1 GB recommended).

Peripherals: Mass storage is required. The volume and diversity of output data make text printers highly desirable and text/graphics plotters are useful.

Language: SIMSCRIPT II.5, VAX FORTRAN.

Documentation: RAMFIRE Users Input Guide. Scenario Automated Graphics Assistant (SAGA) and Scenario Entry (SENTRY) Users Guides are available for IMAGES user.

SECURITY CLASSIFICATION: Model code is unclassified. Most weapon system performance and vulnerability/lethality input data is classified Secret.

GENERAL DATA:

Data Base: Data base development is resource intensive and scenario dependent. Extensive weapon system data base is available for authorized users. Scenario specific data (decision tables, movement files, organization, etc.) generally require 4 to 12 months manual development, 1 to 3 months for skilled modelers with automated assistance.

CPU time per Cycle: Currently, troop/company battles require approximately 1.5 hours per scenario replication and brigade/regiment (approximately 900 combatants) battles require 10 to 11 hours of CPU time per replication on a 7.5 MIPS Processor with 32 MB RAM.

Data Output Analysis: One to three weeks.

Frequency of Use: Daily.

Users: RAM, Inc., OPTEC Threat Support Activity, Air Defense Program Executive office, Program Manager Line-of-Sight Forward Heavy, Program Manager Air-to-Air Missile, U.S. Army Infantry School, Unmanned Ground Vehicle Joint Project Office, Foreign Science and Technology Center, Westinghouse Electric Corp.

Comments: RAMFIRE is not the government reference version of CASTFOREM (Combat Arms and Support Task Force Evaluation Model). It is a derivative of CASTFOREM and the U.S. Army owns unlimited rights to the RAMFIRE model. Configuration management of RAMFIRE is maintained under a tailored DOD Standard 2167 environment. Model code and simulation results are highly stable. Correlation has been achieved for model representation of air defense systems compared to the results of actual field tests of the systems.

TITLE: RAPIDSIM - Rapid Intertheater Deployment Simulation Model.

DATE IMPLEMENTED: 1970.

MODEL TYPE: Analysis.

PROPONENT: Logistics Directorate, The Joint Staff, The Pentagon, Washington, DC.

POINT OF CONTACT: Gail Sweet, (703) 694-7899, AV 224-7899.

PURPOSE: RAPIDSIM provides Joint Staff (J-4) planners with a deployment simulation model that helps achieve a rapid movement of combat and support units required for contingency operations. It is a research and evaluation tool that deals with force capability and requirements and resource planning.

DESCRIPTION:

Domain: Land, air, and sea.

Span: Accommodates any theater depending on data base.

Environment: N/A.

Force Composition: Joint and combined forces.

Scope of Conflict: Conventional.

Mission Area: Conventional mission.

Level of Detail of Processes and Entities: Individual aircraft and ships.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step and event-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Requires FORTRAN compiler and cannot be executed on a PC.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Scenario builder produces environment for the simulation (airlift/sealift assets, capacities, availabilities). MORSA Data Base System produces movement requirements from OPLAN TPFDDs and JPAM data bases.

OUTPUT: Provides detailed reports on simulation activity and produces tabular reports and graphic displays. Postprocessor is available to produce additional reports.

HARDWARE AND SOFTWARE:

Computer:	Runs on the VAX under VMS and the IBM under TSO.
Storage:	75 MB.
Peripherals:	Minimum requirements: one printer and one terminal.
Language:	FORTRAN.
Documentation:	RAPIDSIM manual.

SECURITY CLASSIFICATION: Model is unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Two days.

CPU time per Cycle: Size dependent (from 5 to 40 minutes of CPU time).

Data Output Analysis: Graphic displays and tabular reports , .oduced by postprocessor aid in analysis.

Frequency of Use: N/A.

Users: Naval War College, CENTCOM, EUCOM, Joint Warfare Center, PACOM.

Comments: N/A.

TITLE: RDSS - Regional Development Simulation System.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis, training, and education.

PROPONENT: J-8 Political Military Affairs Directorate.

POINT OF CONTACT: LTC Steven G. Starner.

PURPOSE: RDSS is a system dynamics model of lesser developed nations. RDSS is used as a decision aid tool in testing various policy alternatives available to the U.S. and to other developed nations to impact the lesser developed nation. It is also used as a training and education tool (seminar exercise driver) in operational and strategic level gaming within the low intensity conflict environment.

DESCRIPTION:

Domain: The Third World.

Span: Accommodates any Third World country depending upon data base; initial effort has been oriented toward Central America.

Environment: Models changes of political, social, economic, and military variables in Third World nations based on changes in internal policies and external programs.

Force Composition: Those internal and external social, political, economic, informational, and military forces affecting development in a Third World nation.

Scope of Conflict: Low intensity conflict; primarily insurgency/counter-insurgency, FID/IDAD, and counter-drug.

Mission Area: Both military and nonmilitary operations in low intensity conflict.

Level of Detail of Processes and Entities: Strategic and operational details. Focuses on interaction between social, political, economic, informational, and military actions. Political entity is the social/political group; military is the national aggregate forces; economic is the national economy represented in four sectors.

CONSTRUCTION:

Human Participation: Does not model the policy making process, host nation policies and external programs are provided as inputs.

Time Processing: Dynamic, time-stepped, primarily designed for 5- to 10-year runs using quarterly time-steps.

Treatment of Randomness: Basically deterministic model, randomness treated by changes in inputs.

Sidedness: Multi-sided model, two-sided within a nation, but multiple external actors.

LIMITATIONS: In prototype stage. Primarily applicable to strategic and operational levels. Aggregates national resources and does not consider subdivisions of a nation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Increased capability to model groups and organizations within the society; capability to model more than one opposition group.

INPUT: Scenario consisting of present state of the country, policy decisions over the run time and external programs planned over the run time.

OUTPUT: Produces graphs and tables of changes over time of any of the social, political, economic, informational, and military variables contained in the model; focuses on changes in popular support.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a Macintosh with at least 4 meg memory and 68030 processor (SE/30, IIsi, IIci, or FX).
Storage:	Hard drive required, at least 20 MB to store model and data bases.
Peripherals:	None required; printer useful.
Language:	Developed with IThink (Stella) and S**4 with a HyperCard user interface (commercially available packages).
Documentation:	Currently documented with a user's guide and data dictionary.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Population of a data base for one country requires two weeks to several months depending on the planned use of the simulation.

CPU time per Cycle: Dependent on hardware configuration; however a ten year run using S**4 and a Macintosh IIci is approximately 5 minutes.

Data Output Analysis: Graphs and tables output by the model may be used by the analyst or gamer directly or transferred to spreadsheet applications for additional analysis.

Frequency of Use: A new model; USSOUTHCOM has planned on its Pol-Mil analyst frequently using the model; gaming applications have also been scheduled.

Users: J-8 PMAD, SOUTHCOM, Army War College.

Comments: Managed by J-8 PMAD based on comments from users. Remains under development and continually upgraded based on priorities established by users.

TITLE: RECCE - Reconnaissance Mission Planning Aid.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Warfare Center, Studies and Analysis Directorate, San Antonio, TX 78243-5000.

POINT OF CONTACT: AFEWC/SAV, Building 2000, Kelly AFB, San Antonio, TX 78243. DSN: 969-2706, Comm: (512) 977-2706.

PURPOSE: RECCE predicts whether a reconnaissance asset can receive the signals from radar or communications sites in an order of battle (EOB). For each site in the EOB, RECCE calculates the power received by the reconnaissance asset and compares the received power level against the receiver sensitivity to predict signal collection capability.

DESCRIPTION:
Domain: Land, air, and sea.

Span: Global (depending on the location of the order of battle whether it is electronic, air, naval, or army).

Environment: Uses Defense Mapping Agency (DMA) terrain data and World Data Base II country and political boundaries.

Force Composition: Joint and combined forces, Blue, Red, Grey (entire data base can be modified).

Scope of Conflict: Primarily conventional warfare.

Mission Area: Electronic Combat.

Level of Detail of Processes and Entities: Entities: RECCE can model an entire radar/communication's order of battle (hundreds of sites) or just a single site. Electronic order of battles (EOBs) are categorized by function (such as early warning or target tracker) or modulation type (such as AM or FM). Processes: It incorporates scenario geometries, site locations, Defense Mapping Agency (DMA) terrain, and transmitter and receiver beam dimensions, ERPs, sensitivities, and frequency ranges. The user can add, move, delete, or change the parameters of sites. Analysis of electronic combat effects for each site is displayed such as signal collection range, radar/threat coverage involving terrain masking, and stand-off jamming effects on the reconnaissance platform.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Static.

Treatment of Randomness: All calculations are deterministic.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Graphics require Tektronix (PLOT10) terminal. All sites with the same id must use the same parametric data. Signal propagation considerations are limited to diffraction, refraction, and absorption in the 20 - 20,000 Mhz frequency range. Receiver signal processing is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modifications will be made based on user input.

INPUT: Terrain, radar/communication parameter files, known site locations, reconnaissance asset power parameters and routes.

OUTPUT: Produces scaled (TPC, ONC etc.) overlay transparencies for ranges of reception, SAM lethality, and radar coverage for each site in the order of battle. Graphics also show symbols, text and various user aids. Text summary files are produced for further numeric analysis.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	25 Megabytes plus terrain.
Peripherals:	1 or more Tektronix terminals, Bruning plotter, Tek 4693 or 4694 printer, standard text printer.
Language:	FORTRAN, PLOT10 (Graphics), DCL.
Documentation:	User and Programmer manuals available.

SECURITY CLASSIFICATION: Unclassified - source code. Classified - various data bases and data files.

GENERAL DATA:

Data Base: Dependent upon method of entering OB data base: manual--minutes per site, or automated--sites per minute.

CPU time per Cycle: Dependent on OB data base size and user needs.

Data Output Analysis:

Frequency of Use: To be installed at 2 SAC operating locations in late 1991.

Users AFEWC, SAC.

Comments: None.

TITLE: REDCAP - Real-time Electromagnetic Data Processor and Analyzer.

DATE IMPLEMENTED: 1965, with numerous upgrades up to the present.

MODEL TYPE: Analysis and training and education.

PROPONENT: Air Force Development Test Center (AFCTC), Eglin AFB, FL.

POINT OF CONTACT: David R. Beck, Calspan Corp., Buffalo, NY (716) 631-6819.

PURPOSE: REDCAP is a real-time closed loop, hardware-in-the-loop, man-in-the-loop threat command and control simulator. The REDCAP system simulates the air picture development and distribution using validated threat simulations of both manned and simulated EQ/ACQ radar and appropriate command and control centers. REDCAP provides high fidelity weapons control for both threat interceptors and SAM systems. REDCAP is used to evaluate EC effectiveness of actual equipment (breadboard, brassboard, and flight ready hardware), and tactics.

DESCRIPTION:

Domain: REDCAP simulates either a tactical or strategic threat integrated air defense system (IADS). The simulated IADS includes ground, naval and airborne radars, command posts, weapons control centers and air defense weapons systems. Some of the ground radars are simulated using real receivers operating as radio frequencies.

Span: REDCAP simulates a local or regional threat air defense structure functionally equivalent to an air defense zone.

Environment: Actual DMA terrain data can be used to represent the problem area. The simulation is not limited to any time of day or location. A high fidelity statistical clutter generation capability is provided for REDCAP AEW systems.

Force Composition: Threat (red) zone level IADS or specified components of that IADS vs. a penetrating blue strike package.

Scope of Conflict: Conventional air defense weapons (e.g., SAMs, AI missiles, guns).

Mission Area: IADS penetration, EC effectiveness.

Level of Detail of Processes and Entities: Key decisions making positions in the IADS are manned for air picture development, distribution, and weapons control. Actual displays are available for command and control, radars, and weapons control. Individual air defense weapons such as actual interceptors can be represented or representation can be at higher level of SAM control. Attrition for individual aircraft engagements are Monte Carlo based probability of kill.

CONSTRUCTION:

Human Participation: Human participation is essential in REDCAP for both decisions and processes. The simulator runs in real-time and continues in the absence of human decisions.

Time Processing: REDCAP is a real-time simulation with men-in-the-loop. It is very dynamic.

Treatment of Randomness: REDCAP is a man-in-the-loop simulation. This results in an accurate representation of expected variability. The simulation like real life is never exactly repeatable.

Sidedness: REDCAP is a two-sided (red and blue) asymmetric reactive simulation.

LIMITATIONS: Approximately 200 air targets, 256 ground signals at RF, 87 communications signals at RF, 5-7 manned radars, 3 levels of command and control, up to 40 participants.

PLANNED IMPROVEMENTS AND MODIFICATIONS: REDCAP is currently being upgraded. These upgrades will provide more modern threat simulations of radars, command and control centers, weapons control post, data links, IFF/IBS signals and air interceptors. This upgrade is a major program that will be completed in the mid-1990's.

INPUT: Threat laydown, planned blue flight profiles (unless dynamic), C2 reporting structure and links, radar cross sections, antenna patterns, threat intelligence updates and DMA terrain. REDCAP maintains a data base of selectable input parameters. A test requires human operators and may have actual ECM equipment.

OUTPUT: Both raw and statistically analyzed data is available. Printouts and plots of events and system state vectors can be generated. RF waveforms are generated as output for display to stimulate systems under test. Output products are often tailored for each test.

HARDWARE AND SOFTWARE:

Computer:	An IBM 3031 (MVT) and DEC VAX-11/780 (VMS) network drive custom built RF signal processors and receivers. Several DEC LSI-11 minicomputers are used to both drive manned displays and generate high fidelity clutter.
Peripherals:	Numerous special purpose manned simulator consoles, several data entry consoles, printers, plotters, tape drives, several IBM compatible PCs.
Language:	IBM Assembler H, VAX Bliss, VAX MACRO Assembler.
Documentation:	VAX code fully documented, limited documentation on IBM code.

SECURITY CLASSIFICATION: REDCAP is always operated in a secure mode with a minimum classification of SECRET/NOFORN/WNINTEL.

GENERAL DATA:

Data Base: Two months to one year depending on problem.

CPU time per Cycle: REDCAP is a real time simulation.

Data Output Analysis: A data reduction and analysis system produces output products post mission.

Frequency of Use: Several major test programs each year.

Users: SAC, MAC, TAC, JEWC, NRL, AFDTC, DOD, NATO.

Comments: REDCAP has successfully been linked real-time to the ACETEF, AFEWES and EMTE test facilities to provide realistic real-time threat command and control to remote testing activities. A link to the ECITF is planned.

TITLE: RESA - Research, Evaluation, and Systems Analysis Facility (formerly Interim Battle Group Tactical Trainer [IBGTT]).

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: Naval Ocean Systems Center, San Diego, CA 92152.

POINT OF CONTACT: Dr. Tom Fitzgerald, (619) 553-3968, AV 533-3968.

PURPOSE: RESA is a research and evaluation tool for systems analysis and testing associated with naval command, control, and communications systems. It is also used for operation plan evaluation, command and control training support for senior officers, joint C3 interoperability assessment, warfare systems architecture analysis, and wargaming support.

DESCRIPTION:

Domain: Naval and air operations; limited land warfare modeling.

Span: Focus on naval battle group/force operations in the theater context.

Environment: Weather conditions in 24 geographic regions affect flight operations weapons and sensor performance. Four acoustic environment conditions affect sonar performance.

Force Composition: Naval ships, submarines, bases, and air forces; air force bases and air elements; BLUE, ORANGE, and NEUTRAL.

Scope of Conflict: Mostly conventional. Modeled nuclear effects available.

Mission Area: All naval conventional areas; limited mine warfare and amphibious operations capabilities; joint air defense and strike operations.

Level of Detail of Processes and Entities: Models battle group and force at level of ships, submarines, and aircraft (individual units or collective flights) and associated weapons, sensor, and C3I systems. Includes models of shore bases and wide-area surveillance systems and surveillance satellites that may support battle force operations. Record and link communications models affect perceived tactical situation. Logistics available from ships and bases modeled. Kinematics models include navigation error.

CONSTRUCTION:

Human Participation: Responses to tactical situation must be made. May replicate scenario activities of forces by prescript of f ce actions or scenario with new random number seed in auto-replay m[illegible]

Time Processing: Time-step at user-defined rate from [illegible] seconds per game cycle. In large scenarios may be limited to 15-30 seconds per game cycle depending on host computer. One game cycle equals one game minute.

Treatment of Randomness: Stochastic, direct computation of a physical parameter and Monte Carlo determination of result.

Sidedness: Basically two-sided, symmetric, reactive. BLUE and ORANGE forces may be partitioned into up to nine views of the tactical situation. A NEUTRAL side may also be defined and operated by the control function.

LIMITATIONS: No land warfare or terrain modeled. Scenario size limited to 400 units (being expanded to 4096).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Current development of terrain model and improved mining, amphibious, and naval coastal operations; current expansion of force unit capacities; and planned improvement of land warfare and air-to-ground operations models.

INPUT: Characteristics of forces, weapons, sensors, and C3I systems. Definition of scenario initial force locations, C3I networks, environmental conditions, and wide-area surveillance systems in use.

OUTPUT: Minute-by-minute tactical situation in geographic plot format and 30 menus of alphanumeric data pertinent to situation; postgame analysis printouts of all force positions, detections, engagements, and communications occurring during the scenario; and perhaps LINK-11, RAINFORM, and JINTACCS formatted message streams in response to scenario events.

HARDWARE AND SOFTWARE:

Computer:	VAX computer with VMS operating system.
Storage:	100,000 blocks for executables, files, and data base for moderate scenario.
Peripherals:	One command center includes one VT-100 (or equivalent) input-output terminal, one geographic display (e.g., TEKTRONIX 4209) and up to four VT-100s for status board displays. Software allows up to 16 command centers per remote site computer and host computer to drive up to 16 remote site computers.
Language:	Rational FORTRAN (RATFOR).
Documentation:	Analyst Users Guide (five volumes).

SECURITY CLASSIFICATION: Unclassified. Typically requires data bases with secret data. Unclassified data base being developed.

GENERAL DATA:

Data Base: Modifiable characteristics data bases and scenario files.

CPU time per Cycle: Scenario dependent; most run at 2-1 or better.

Data output Analysis: Limited to a few tailored processes.

Frequency of Use: Approximately 20 exercises per year at NOSC.

Users: NOSC, Naval Postgraduate School, Naval War College, NSWC, NRL, DCA, RADC, Warrior Preparation Center (Ramstein AFB, FRG), U.S. Army CECOM, U.S. CINCPAC, U.S. CENTCOM, and ROK/U.S. Combined Forces Command.

Comments: Was basis for initial development of ADSIMS (now AWSIMS). Basic simulator for JDLNET to provide distributed joint C3I analysis support.

TITLE: RETCOM - Return to Combat.

DATE IMPLEMENTED: 19 April 1985.

MODEL TYPE: Analysis.

PROPONENT: Logistics Center, Ft. Lee, VA.

POINT OF CONTACT: Charles Holmes, AV 687-3347/3610.

PURPOSE: RETCOM was designed to examine the reliability, availability, and maintainability (RAM) of candidate ground weapon systems in COEAs and of a single system type belonging to a peacetime or combat force engaged in a series of activities and missions. During these missions, systems that have suffered combat damage are if possible repaired and returned to the force. RETCOM differs from force-on-force models in that the BLUE forces' activities are portrayed to generate maintenance requirements, not RED casualties.

DESCRIPTION:

Domain: Land.

Span: Defined mission scenario and associated levels of maintenance.

Environment: None necessary.

Force Composition: User defines BLUE organization as a major unit (e.g., division, battalion, or task force) composed of subunits (e.g., companies) to which systems are assigned. User may define his combat units as companies, platoons, squads, or any combination thereof, and need not assign the same number of systems to each combat unit.

Scope of Conflict: BLUE weapon systems are represented for RAM by subsystems and for combat damage by exposed areas vulnerable to enemy munitions. User defines enemy weapons by specifying the different RED weapon types.

Mission Area: Combat force missions.

Level of Detail of Processes and Entities: Combat attrition portrayed as a function of the enemy weapon array and rate of fire. BLUE system posture and unit strength or number of unit systems committed to action. Processes such as attrition, system performance, combat damage, system abandonment, maintenance demands deferred unscheduled maintenance downtime, and scheduled and unscheduled maintenance downtime affect above entities.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic.

Sidedness: One-sided.

LIMITATIONS: No geography and no RED casualties.

PLANNED IMPROVEMENTS AND MODIFICATIONS: To make the program/model available to IBM compatible desktop computers.

INPUT: Number of systems to be simulated; maintenance structure control variables; recovery; number of systems available for missions, RED weapon types available, and BLUE systems; combat hit rate; sampling distributions; normal damage assessment; active repair time; cannibalization; random number generator; maintenance assets; number of recovery vehicles, replications, missions segments, and combat units; total maintenance elements; number of maintenance elements in battalion and crew number of systems per combat unit; special maintenance equipment; vulnerable area description; combat attrition control tables and damage repair data; mechanical subsystem description and repair data; RAM repair location; preventive maintenance; and alternate spare data.

OUTPUT: Printed summary information describing the results of each individual replication and all cumulative replications for a given alternative such as distance traveled by the system; fuel used by the system; rounds fired by the system's primary, secondary, and tertiary weapons; total maintenance downtime during the scenario; deferrable maintenance downtime during the scenario; operational uptime; standby time; operational availability; total outstanding maintenance hours remaining after end of the scenario; nondeferrable outstanding maintenance hours remaining; outstanding preventive maintenance hours remaining; delay time without cannibalization and using cannibalization; total unscheduled maintenance actions; deferrable unscheduled maintenance actions; nondeferrable unscheduled maintenance actions; and the number of nonrecoverable incidents, scheduled maintenance actions, repairs necessitated by combat damage, irreparable combat occurrences, nonrecoverable combat damaged systems, and replaced systems.

HARDWARE AND SOFTWARE:

Computer: SPERRY 1100 series/SPERRY Executive Language.
Storage: N/A.
Peripherals: Printers and modems.
Language: SIMSCRIPT II.5.
Documentation: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Time needed to prepare data base.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: N/A.

Users: N/A.

Comments: Any further information required is available in the user's manual. RETCOM is a TRADOC model.

TITLE: REVAM - RPV EW Vulnerability Assessment Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Vulnerability Assessment Laboratory, LABCOM, Ft. Monmouth, NJ 07703.

POINT OF CONTACT: Peter Bothner, (201) 544-3773.

PURPOSE: REVAM is used to analyze the EW performance of RPV data links.

DESCRIPTION:

Domain: Ground-to-air model.

Span: Intended for 100 km x 100 km area.

Environment: Models the signal and EW environment to determine data link performance.

Force Composition: Considers RED and BLUE deployment and employment strategies and terrain to establish anticipated levels of performance.

Scope of Conflict: Conventional warfare only.

Mission Area: Developed to validate artillery target acquisition mission of the RPV.

Level of Detail of Processes and Entities: Model was developed to perform parametric analyses of data link EW performance based on RED and BLUE deployments, tactics, threat levels, and terrain.

CONSTRUCTION:

Human Participation: Menu-driven interactive model.

Time Processing: Approximate run time is one half hour per RPV flight profile.

Treatment of Randomness: Deterministic model that can be used to compare one run with others.

Sidedness: Only one operator can exercise the model at any given time.

LIMITATIONS: REVAM is written in HP BASIC, which limits it transportability. Currently, REVAM does not model multipath or weather.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model architecture readily lends itself to improvements and modifications. However, there are no funds available to pursue enhancements.

INPUT: SCORES scenarios, data link and threat characteristics, tactics, RPV flight profiles, and propagation losses.

OUTPUT: Printouts of all data files, plots scenario laydown, and plots J/S environment at the antenna and at the output of the adaptive antenna processor to reveal AJ margin of the data link.

HARDWARE AND SOFTWARE:

Computer: HP9836 desktop computer.
Storage: One MB RAM and two 5.25-inch double density floppy disk drives.
Peripherals: HP-compatible matrix printer and plotter.
Language: HP BASIC.
Documentation: Available from Hewlett Packard.

SECURITY CLASSIFICATION: Classification depends on the input and output data, which are normally SECRET. REVAM source code is unclassified.

GENERAL DATA:

Data Base: DMA terrain data, SCORES scenarios, and any desired threat data classified below top secret.

CPU time per Cycle: Problem-dependent.

Data Output Analysis: Data output selected by the analyst is reduced and plotted by the model.

Frequency of Use: Varies.

Users: LABCOM, TECOM, and MICOM.

Comments: REVAM should be coded in FORTRAN to improve transportability.

TITLE: RJARS - RAND Jamming Aircraft and Radar Simulation.

DATE IMPLEMENTED: Under development 1991.

MODEL TYPE: Analysis.

PROPONENT: RAND, 1700 Main Street, Santa Monica, CA 90407.

POINT OF CONTACT: William Sollfrey, (213) 393-0411; Edward Harshberger, (213) 393-0411.

PURPOSE: RJARS is a detailed many-on-many, ground-to-air defense model designed to examine raid level survivability of air vehicles against radar, infrared, and optical threats. It incorporates terrain, multipath, and clutter for radar calculations, along with weather and time-of-day effects for infrared and optical calculations. It treats system effectiveness issues.

DESCRIPTION:

Domain: Land and air.

Span: Regional to local.

Environment: Detailed terrain relief, terrain type, weather, time of day.

Force Composition: Individual weapon systems and subsystems.

Scope of Conflict: Conventional.

Mission Area: SEAD, CAS, OCA, DCA.

Level of Detail of Processes and Entities: Entities are modeled at the level of detail of individual weapon systems (e.g., aircraft, SAMS, radars). These entities can be given pre-scripted movement plans. Command and control logic and firing logic are coded, the sequence and timing of events being a function of model inputs (e.g., decision delays). Attrition is the primary outcome of the simulation and is evaluated based upon detailed modeling of aircraft/SAM encounters.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Time-step.

Treatment of Randomness: Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Limited in detailed treatment of radar and countermeasures phenomenology. No air-to-air modeling or keep-out is associated. Offense flies a nonreactive flight path.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved modeling of continuous wave, pulse doppler, and modern phased-array radar phenomenology. Improved C3 system to three-level command and control. Upgrades to gun and EO-backup models.

INPUT: Standard libraries of defensive and offensive system characteristics. Preprocessors aid in development of scenario files with defense laydowns, offensive flight paths, command and control network, and input flags.

OUTPUT: Time-stepped situation printout for all penetrators and defensive systems. Event listing. Summary statistics file. Graphic postprocessor playback file.

HARDWARE AND SOFTWARE:

Computer: Sun Sparcstations under Unix, 16 meg RAM, 32 meg swap suggested.
Storage: Variable - 60 meg suggested.
Peripherals: None necessary, printer suggested.
Language: Written in C. Preprocessor and postprocessor designed for TAE environment under X windows.
Documentation: Two manuals published.

SECURITY CLASSIFICATION: Unclassified, but data is often classified.

GENERAL DATA:

Data Base: Libraries exist. Scenario development can take days to weeks.

CPU time per Cycle: Minutes to hours depending on scenario size.

Data Output Analysis: Graphic postprocessor, summary statistics.

Frequency of Use: Under nearly continuous use.

Users: RAND internal use.

Comments: Under internal configuration control by a working group of RAND internal project users.

TITLE: RPM - Rapid Production Model (Ver.5).

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Joint Strategic Target Planning Staff, JSTPS/JKAW, Offutt AFB, NE 8113; Chief of Naval Operations (OP 65), Washington, DC.

POINT OF CONTACT: JSTPS: LCDR West, DSN 271-5836, Comm (402) 294-5836.

PURPOSE: RPM is a computerized, analytical model designed to provide the capability for concise, detailed study of strategic force exchanges.

DESCRIPTION:
Domain: Missile and bomber forces.

Span: Accommodates any theater depending on data base.

Environment: N/A.

Force Composition. Joint and combined forces for multiple sides.

Scope of Conflict: Nuclear warfare.

Mission Area: SIOP.

Level of Detail of Processes and Entities: Functions may be performed with either a few or many warheads and/or vehicles of different types, and with a few or many targets. User must impose structure which balances complexity as the combinatorial problem may become too cumbersome.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic event processing.

Treatment of Randomness: RPM is an expected value model with Monte Carlo options.

Sidedness: Although used extensively for two-sided exchanges, the RPM model can be used to simulate the results of multi-sided exchanges.

LIMITATIONS: Commits bombers, but does not recycle them. Does not simulate refueling. Illustrates cruise missile routes for demonstration only.

INPUT: RPM operates in a batch mode, requiring an input stream of commands and data. Input consists of RPM commands which specify the tasks to be performed and the set of data to be used. The quantity of input varies with the size of the problem. Problems typically use installation data which range from fewer than one hundred sites to data which contain thousands of installations. Weapon system inputs also vary with the problem, from one weapons system to the full arsenal.

OUTPUT: RPM produces computer printouts of direct and collateral damage for a combination of point and/or area targets. Fallout casualties are also available. Quantity of output varies with the level of detail requested by the user. File output is possible, and is used as input to other RPM executions.

HARDWARE AND SOFTWARE:

Computer: IBM 3081D MVS/XA; SUN SPARC OS 4.0; CDC Cyber 175 NOS.
Storage: IBM: 2 MB.
Peripherals: 1 Printer.
Language: FORTRAN V.
Documentation: RPM Call Reference Manual; User's Manual and Test Plan Manual.

SECURITY CLASSIFICATION: Unclassified without data bases.

GENERAL DATA:

Data Base: Large data bases can require several weeks to build.

CPU time per Cycle: Dependant on detail desired and data base size.

Data Output Analysis User must perform analysis of output.

Frequency of Use· Daily.

Users: JSTPS, OP-65, and others.

Comments: Product of Academy for Interscience Methodology.

TITLE: RSAS - Rand Strategy Assessment System.

DATE IMPLEMENTED: 1988 (development began in 1983).

MODEL TYPE: Analysis (but has been used as a training model/exercise driver).

PROPONENT: Director, OSD/NA, The Pentagon, Room 3A930, Washington, DC 20318.

POINT OF CONTACT: CDR Robert Wilde, USN, (703) 697-1312, AV 227-1312.

PURPOSE: RSAS provides a laboratory for the analysis of military strategy and operations in which alternative strategies and operations are evaluated in terms of the robustness of outcomes across the inherent range of uncertainty in scenarios, performance factors, and rules of war. RSAS can also be used for training and other requirements.

DESCRIPTION:
Domain: Land, air, sea, and limited space.

Span: Conventional and nuclear combat in data bases representing Northern, Central, and Southern Europe; Korea; and Southwest Asia theaters; naval combat in all oceans and major seas.

Environment: Four environments: main theater model (CAMPAIGN), alternate theater model (CAMPAIGN-ALT), naval model, and nuclear models. CAMPAIGN's geographic resolution is moderate and grid-based. Terrain is considered in an aggregate fashion as a function of the effect of terrain on maintaining or executing an offense or supporting a stalemate. CAMPAIGN-ALT encompasses a network of points and LOCs that explicitly account for terrain factors and geographic constraints in force movements and combat adjudication. The naval model allows aggregate differences in ASW, AAW, and ASUW in ocean regions based on variations in acoustic and environmental conditions. Nuclear models consider only environmental factors implicitly included in damage assessment criteria.

Force Composition: Nuclear forces played at individual weapon and weapon platform level. BLUE, RED, and GREEN joint and combined forces portrayed worldwide via a data base resident in the model.

Scope of Conflict: Theater and global conventional, theater nuclear, or strategic nuclear.

Mission Area: All conventional, theater, nuclear, and strategic nuclear areas.

Detail of Level of Processes and Entities: Individual weapons and weapon platforms modeled in the nuclear models. In the CAMPAIGN model, ground forces are modeled at the level of RED divisions and BLUE brigades (including most allied forces), air forces at the level of RED air regiments and BLUE air squadrons, and naval forces at the level of individual ships. Combat adjudication highly aggregated, but includes many parameters affecting theater-level combat that are only implicitly controlled by more fine-grain models. Combat adjudication output includes force attrition, FLOT location, force ratios, and aggregate damage levels.

CONSTRUCTION:
Human Participation: Permitted for all decisions, but the system can be run in an automatic mode relying on scripted decision log that makes all national-level, strategic, and theater-level decisions.

Time Processing: Dynamic, time- and event-step. Events at 12-hour, 4-hour, or 6-minute intervals depending on combat type.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, asymmetric, and reactive. Single operator can test and operate model.

LIMITATIONS: Continuous development intended to identify and improve areas of limitation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Areas of limitation are being improved as recommended by DOD Steering and Working groups, with the authorization of OSD/NA. Additional land theaters are under development.

INPUT: Model comes delivered and ready to run.

OUTPUT: Graphic and tabular output of the results of combat adjudication. Comparison of multi-scenario runs also possible.

HARDWARE AND SOFTWARE:

Computer:	Run on a SUN 3 family of systems under SUN OS 3.5.
Storage:	300 MB of disk space and 12 MB of memory recommended.
Peripherals:	Printer if desired.
Language:	"C" and RAND-ABEL (which compiles into "C").
Documentation:	Extensive descriptive documentation, but no true operating manual. Operating documentation being developed by a subcontractor.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: A complete, easily modifiable data base accompanies the model.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: Varies by command, but is used at least several times per year with increasing frequency by those listed below.

Users: OSD, the Joint Staff, NDU, Naval Postgraduate School, Air College, CIA, DIA. Other users coming online: PACOM, EUCOM, and other CINCs.

Comments: J-8 is currently evaluating model. RAND point of contact is Dr. Bruce Bennett, (202) 296-5000.

TITLE: RVAS - Radar Vulnerability Analysis System.

MODEL TYPE: Analysis.

PROPONENT: AFEWC/SATR, San Antonio, TX 78243.

POINT OF CONTACT: Mr. James L. Havens, DSN 969-2392, (512) 977-2391.

PURPOSE: Used to determine the jammer to signal ratio required for a specified jamming technique to successfully jam the radar of interest.

DESCRIPTION:
Domain: N/A.

Span: N/A.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Entity: Radar and jammer waveforms and signal processing functions are modeled. Processes: Models target signature signal and jammer waveforms in both time and frequency domains, using real and imaginary components for high fidelity. Establishes energy ratio of jammer, plus signal to signal ratio (J+S/S) by first determining the "S" output, and then adding the jamming waveform to determine "J+S". The receiver model is based on only those functions that may affect this ratio. The output ratio is then compared with a predetermined required signal level. This required signal level is predetermined by analysis or testing of the affected radar circuit. The jamming power is incremented until the proper comparison is met. The input jammer power divided by the signal power is then the J/S required.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic time-step model.

Treatment of Randomness: Deterministic calculations, but can generate stochastic noise signals.

Sidedness: One-sided.

LIMITATIONS: Does not model closed loop systems.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

HARDWARE AND SOFTWARE:
Computer(OS): MicroVax II computer.
Storage: Nine megabytes plus operating system.
Peripherals: Graphics terminal and printer.
Language: FORTRAN.
Documentation: RVAS user's manual and reference material.

SECURITY CLASSIFICATION: The model without data is unclassified.

GENERAL DATA:

Data Base: 1 to 3 hours of preparation are required for each model.

CPU time per Cycle: 1 to 2 hours are required for an analysis cycle dependent on model complexity.

Data Output Analysis: Graphics aid in analysis of the printed output report.

Frequency of Use: Varies with tasking, but 8-12 weeks per are normal.

Comments: Model uses nonstandard software.

TITLE: SAAMBO II - Signature of Air-to-Air Missiles After Burnout II.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The SAAMBO II program calculates the aerodynamic heating thermal self-emission signatures of various kinds of airborne vehicles. The program was developed to model accelerating and coasting AAM; however, it may also be used to simulate cruise missiles, long-range AAM, or constant velocity aircraft.

SAAMBO II was developed to provide aerodynamic heating signatures of coasting missiles. SAAMBO II is an upgrade of SAAMBO-SA, a stand-alone version which includes internal algorithms to calculate atmospheric properties based on altitude and simplified input parameters for skin properties when a steady-state solution is requested. This version incorporates several improvements beyond the original version including:

- Types of surface shapes modeled,
- Treatment of "wet walls" (internal fuel tanks),
- Flexibility of viewing aspect angles, and
- Calculation for up to four user-specified wavebands.

DESCRIPTION: The SAAMBO II program may be used to calculate the transient aerodynamic heating radiance from targets, such as an AAM or the steady-state thermal radiance, and an object, such as a low acceleration aircraft. The vehicle altitude, speed, and viewing aspect angle may change with time. The subject vehicle is modeled as a combination of generic surfaces with similar thermal and radiometric properties. The program calculates the skin temperature and the resultant radiant emittance as a function of time during vehicle flight. Program output consists of spectral radiant existence and waveband integrated intensity values as a function of time.

The major elements of radiative infrared (IR) signatures of AAM at forward aspect angles are the plume and thermal emissions of the skin. The plume consists of the hot exhaust products of the solid rocket motor, and the thermal emission due to aerodynamic heating of the missile skin. At burnout, the plume signature disappears, leaving the much weaker (perhaps four orders of magnitude lower) skin thermal radiation. IR signatures can change fairly rapidly with time since typical missile speeds peak sharply at burnout and decrease rapidly thereafter. The transient mode of the program calculates time-dependent IR signatures.

Other targets such as cruise missiles, long range AAMs, and nonafterburning aircraft tend to undergo much smaller acceleration than AAMs. For these targets, the plume signature may be dominated by the aerodynamic heating of the body, particularly for forward viewing aspects in the far IR waveband region.

From IR images of aircraft in flight, it has been noted that internal fuel can affect the outer skin temperature, and therefore, affect the thermal signature. This can occur if the fuel is in good thermal contact with the outer skin. Many cruise missiles contain such integral fuel tanks, with a large section of the missile fuselage skin serving as the fuel tank. Since the heat capacity of the fuel is large compared to that of the thin metal skin, fuel temperature tends to remain relatively constant over time periods of perhaps hours. Fuel in good thermal contact with the vehicle skin tends to moderate the outer surface temperature extremes caused by aerodynamic heating. SAAMBO II models these effects of internal fuel on the outer surface temperature for steady-state solutions.

When an airborne vehicle moves through the atmosphere at supersonic speed, it is heated by the hot boundary layer of air next to the skin. The rate of heat transfer to the vehicle is calculated using vehicle speed, shape, skin temperature, and atmospheric parameters such as temperature, density and dynamic viscosity. A significant factor in the thermal response of the skin is the presence/absence of paint. In general, the influence of heat on the vehicle skin temperature can be calculated by heat transfer methods and depends upon the thermal characteristics of the vehicle skin (thickness, conductivity, and heat capacity). However, for the steady-state solution, thermal equilibrium is assumed, so that no knowledge of skin thermal properties is required.

For the transient condition, the outer skin of the missile is characterized as thermodynamically thin or thick. If the temperature distribution is approximately uniform, it is referred to as "thin." Thin means the material is a good conductor of heat and that heat is being exchanged with the outside world at a relatively slow rate.

If the skin material is thick, it is divided into laminates of appropriate thickness and the temperature is calculated at each layer. For painted thin skins, the temperature of the skin and the painted surface are both calculated. Painted thick skins are not allowed.

INPUT: Atmospheric properties such as temperature, density, pressure, and viscosity are required for the calculation of recovery temperature and heat transfer coefficient. The user may specify the altitude of the vehicle (up to 31 km) as a function of time and SAAMBO II will extract appropriate atmospheric parameters based upon the United States Standard Atmosphere.

The spectral emissivity of each surface is user-specified at ten equally spaced intervals within each waveband. The radiant intensity signature emitted by the heated skin toward an observer is a function of the skin temperature, skin emissivity, and the waveband of observation. Up to four different wavebands may be calculated in one run.

The user divides the vehicle into a small number of subsections. Typical subsections include a hemispherical nose dome, a conical transition section, a cylindrical fuselage, a trapezoidal wing, or canard. A simplified vehicle may be reasonably characterized by four to eight surfaces.

OUTPUT: The output begins with an echo of the scenario parameters and wavebands. Next, information for each surface is presented, including the identification of the surface number. The output is then printed, summarizing the input along with a few important auxiliary variables, and displaying results of the calculation.

Next, the aerodynamics table shows the time, Mach number, altitude, temperature of the paint, and the surface and recovery temperature at the air-surface boundary as a function of time. In addition, this table contains the Mach profile, Stanton numbers, Reynolds number, heat transfer coefficient, and the time constant value versus time.

The "temperature at interior nodes" table is produced only if the surface conductivity was specified as nonzero. This table shows the recovery temperature and the temperature at each of the laminates from the outer wall to the inner surface as a function of time.

The next output is a table of the spectral existence results for the surface as produced by SAAMBO II. This shows the surface temperature, projected areas, and spectral radiant existence, all as a function of time. The spectral emissivity is also displayed. If more than one waveband was requested, this table is repeated for each waveband.

The output is repeated for each surface. Finally, the radiance from each of the surfaces is summed in a table of spectral intensity for the entire vehicle. Printer plots of spectral intensity and temporal intensity are generated, if requested. Certain elements of the above tables may be omitted if requested by the user.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage: 755,842 bytes.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 32.98 seconds; Typical run time: 51.86 seconds.

Users: AFEWC/SAX; BDM Corporation; Loral Advanced Projects; Mitre Corporation; SAIC; WL/AAWW-3.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SAB - Surface-Air Battle.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: SAB models air-to-air, air-to-surface, and surface-to-air detections and engagements (including ship- and sub-launched ASCMs). It is designed to support battle damage assessment in conjunction with larger-scale war games.

DESCRIPTION:

Domain: Sea.

Span: Local.

Environment: N/A.

Force Composition: Attacking and defending aircraft, ship formations.

Scope of Conflict: Conventional battle group sea strike, AAW, ASMD weapons.

Mission Area: Strike warfare, AAW, ASMD.

Level of Detail of Processes and Entities: User defines geographic area, strike composition, armament and flight profiles, and defender CAP stations/armament, and ship formation.

CONSTRUCTION:

Human Participation: Required for initial inputs only.

Time Processing: Closed form.

Treatment of Randomness: Outcomes stochastically based on direct computation of probabilities, with Monte Carlo determination of results.

Sidedness: Two-sided, symmetric.

LIMITATIONS: User input-intensive.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Add surface-to-surface capability.

INPUT: Geographic location, strike composition, armament and flight profiles, defender CAP stations/armament and ship formation.

OUTPUT: Cumulative aircraft losses, individual ship damage and loss (including list of damaged ship components), azimuth and elevation of individual weapon hits.

HARDWARE AND SOFTWARE:

Computer:	IBM-compatible PC with 512K RAM.
Storage:	N/A.
Peripherals:	Printer.
Language:	"C," dBASE III+.
Documentation:	User's manual, design description, source code.

SECURITY CLASSIFICATION: Unclassified, but data base is classified.

GENERAL DATA:

Data Base: One hour.

CPU time per Cycle: N/A.

Data Output Analysis: None.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: SAB is designed to be used in conjunction with the Kinematics and Strike models. Data bases are compatible. Users should be able to move freely among all three models. Ship battle damage results are determined by calling SHIPDAM model as a subroutine. SAB may be used independently to provide battle damage assessment information in support of larger war games.

TITLE: SAR - Search and Rescue.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: USCG R&D Center, Marine Systems Branch, Avery Point, Groton, CT 06340-6096.

POINT OF CONTACT: Clark Pritchett, (203) 441-2653, FTS 642-2653.

PURPOSE: SAR is designed to compare the capabilities of alternative vessels in search and rescue that are being considered for acquisition. This model is a research tool that deals with force capability.

DESCRIPTION:
Domain: Coastal.

Span: Individual rescue vessel.

Environment: Sea state distribution, wind, current, time of day, and sunrise and sunset.

Force Composition: One vessel plays against a distribution of cases.

Scope of Conflict: A case is represented by the survival function; i.e., the probability that the mariner is alive as a function of time.

Mission Area: Search and rescue--may be used for responsive naval missions.

Level of Detail of Processes and Entities: A case is the smallest entity modeled. Cases are processed one at a time, and the results are logged as a life saved, not saved, or not found. Search is based on Koopman's optimal search of an ellipse. Search time changes from day to night and increases as wind and current increase the CEP.

CONSTRUCTION:
Human Participation: Required only for gathering input.

Time Processing: Dynamic; cases stepped through events.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided model in that one rescue vessel is played against a caseload represented by distributions of weather, distance, time of day, CEP, and survival curve.

LIMITATIONS: The measuring stick for the case is the survival function, which is not well defined for search and rescue.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at this time.

INPUT: Case information (i.e., distributions), vessel speed in a seaway environment, and the survival function make up the majority of the inputs.

OUTPUT: Produces vessel operational performance and mission MOEs.

HARDWARE AND SOFTWARE:
Computer: VAX family of computers With VMS.
Storage: Minimal.
Peripherals: Terminal and printer.
Language: FORTRAN.
Documentation: A report describing the model is available.

SECURITY CLASSIFICATION: None.

GENERAL DATA:
Data Base: None.

CPU time per Cycle: Small.

Data Output Analysis: Graphic postprocessor is available.

Frequency of Use: SAR is in the preliminary stage of acquisition.

Users: Coast Guard R&D Center.

Comments: This model could be applied to other operations, such as responding to patrol boat or terrorist attacks.

TITLE: SASS - SIGINT Analysis and Simulation System.

DATE IMPLEMENTED: October 1, 1991.

MODEL TYPE: Analysis.

PROPONENT: Tactical Studies and Analysis (R08), National Security Agency, 9800 Savage Rd., Fort Meade, MD 20755-6000.

POINT OF CONTACT: William C. Edwards, Commercial (301) 688-0592/0593.

PURPOSE: SASS is a research and evaluation tool which provides a modeling and simulation center for the analysis of current and projected signal environments and current and future sensor systems operating in those environments

DESCRIPTION:

Domain: Current capabilities include land, air, and naval operations.

Span: Accommodates any theater depending on data base; current test data base consists of Iraqi air defense forces.

Environment: Models geographic areas of user defined size. Utilizes terrain data and the Longely - Rice propagation model in determining radio line of sight (LOS). Models day and night operations and different degrees of weather.

Force Composition: Joint and combined forces, Red and Blue.

Scope of Conflict: Designed primarily for conventional warfare, but can simulate any signals associated with nuclear and chemical weapons.

Mission Area: All conventional missions and unconventional warfare.

Detail of Level of Processes and Entities: Model defines and develops the necessary communications nets and the various non-communications emitters according to the force composition defined. The model can define emissions down to the individual emitter level. The duty cycle of each emitter type can be represented by a Monte Carlo distribution according to the emitter's parent unit's posture. The Signal Collection simulator can be modeled from the individual component level up to the mix of collection systems level. Model allows for the definition of cause-effect relationships as defined by either time or proximity "triggers."

CONSTRUCTION:

Human Participation: Required for decisions concerning input data bases and analysis parameters.

Time Processing: Dynamic, time- and event-stepped model. Progresses through events at a user-specified ratio of exercise time to real time.

Treatment of Randomness: Equipment operating characteristics (duty cycle) stochastically based on Monte Carlo distribution.

Sidedness: Two-sided, symmetric reactive model utilizing the cause-effect "triggers" in developing the signals environment. The collection simulation is one-sided.

LIMITATIONS: Currently does not model any emitters below 2 MHz. Collection models currently limited to generic tactical collectors.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional, specific tactical collectors, and strategic assets.

INPUT: Input data consists of scenario, force structure, equipment characteristics, geographic area, time window of interest.

OUTPUT: Analysis output displayed in graphical form. Operational map displays can also be generated as can tabular output from the output data base. The data base management system (INGRES) provides the means to analyze the output data base.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	400,000 blocks (205 megabytes) needed.
Peripherals:	Min requirements: 1 printer, 1 workstation, tape cartridge.
Language:	ADA, DecWindows, INGRES.
Documentation:	Documented with module specifications, user's guide, maintenance manual, data dictionary, etc.

SECURITY CLASSIFICATION: Unclassified, but data bases are classified.

GENERAL DATA:

Data Base: Population of large data bases can be labor intensive.

CPU time per Cycle: Dependent on data base size and force configuration.

Data Output Analysis: DBMS aids in analysis of output as does the graphics capabilities of the output facility.

Frequency of Use: Will vary according to customer need for level of detail of analysis.

Users: Currently in-house users while model is being tested.

Comments: N/A.

TITLE: SCAN.

DATE IMPLEMENTED: December 1985.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: SURVIAC (513) 255-4840, AV 785-4840.

PURPOSE: SCAN is a digital computer program developed to predict the probability that an aircraft will survive an attack by a missile armed with a fragmentation warhead.

DESCRIPTION:

Domain: Air.

Span: Individual.

Environment: N/A.

Force Composition: Element.

Scope of Conflict: Conventional.

Mission Area: N/A

Level of Detail of Processes and Entities: SCAN simulates the encounter between a missile and an airborne target and computes the expected target damage. The encounter conditions can be obtained from missile flight simulations, missile performance data, or as user-specified distributions of encounter parameters. SCAN features geometric aircraft representation, missile trajectory generation, missile fuzing computation, damage mechanisms, and target system configuration.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: SCAN does not model blast effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: SCAN requires aircraft/missile geometry, warhead fragment data, aircraft geometrical representation data, missile fusing data, and damage assessment data.

OUTPUT: SCAN produces a terminal encounter summary containing missile trajectory and fuse performance, an aircraft component damage summary, as well as system, subsystem, and total aircraft survivability probabilities.

HARDWARE AND SOFTWARE:

Computer:	VAX and MicroVAX.
Storage:	170 KB.
Peripherals:	N/A.
Language:	FORTRAN V.
Documentation:	SCAN User's Manual, SCAN Analyst Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base:

CPU time per Cycle:

Data Output Analysis:

Frequency of Use:

Users:

Comments: Code and documentation can be obtained from SURVIAC.

TITLE: SCARE - Simulation of a Countermeasures, Aircraft, Radar Encounter.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: USAF Wright Laboratory, Avionics Directorate (WL/AAWP-3), Wright-Patterson AFB, OH 45433-6543.

POINT OF CONTACT: Mr. David Lin, (WL/AAWP-3), (513) 255-2471, DSN 785-2471.

PURPOSE: This research and evaluation tool evaluates the effectiveness of self-protection countermeasures against AA systems. It models aircraft and AA systems, and evaluates a data base for automated threat assessment and reaction systems, assesses the ECM capabilities of radar systems, and serves as a testbed for the development of real-time radar and countermeasure simulations.

DESCRIPTION:
Domain: Aircraft vs. land-based, surface naval AAA or SAM, and airborne interceptor AAM.

Span: Local or individual.

Environment: Engagement over flat earth and select atmospheric attenuation conditions. Neglects ground effects.

Force Composition: BLUE aircraft on RED, GRAY, or BLUE AA systems.

Scope of Conflict: Conventional; mostly tactical aircraft and anti-aircraft systems with many long-range strategic systems.

Mission Area: Penetration through hostile forces by aircraft, air-to-air combat, and survival of aircraft in close air support.

Level of Detail of Processes and Entities: Depends on module and function. Emulates each functional block of radar systems. Includes saturation, AGC, servo loops, target detection, loss, acquisition and reacquisition, search, track, and radar operator interventions. Radar models maintained at several levels of detail. Models aircraft trajectory and radar signature. Trajectory and radar signatures of expendable countermeasures (chaff and decoys) are included together with (passive) radar cross-section modulation models. Active ECM models include selectable waveform modulations, directivity patterns, ERPs, and bandpass (repeater) characteristics. Missile seeker and guidance models developed at emulation level. Missile flyouts governed by input aerodynamic, thrust, mass, and control surface models. SCARE accepts measured data to the greatest degree possible yet provides engineering models to fill data gaps.

CONSTRUCTION:
Human Participation: None; simulation events selected before run time.

Time Processing: Dynamic, event-driven. Each module runs asynchronously with its own time scale requirements.

Treatment of Randomness: Deterministic with stochastic, Monte Carlo processes. Receiver noise, aerodynamic turbulence, and target glint stochastically sampled each run. In the more efficient models, values are generated as a function of expected value.

Sidedness: Two-sided, asymmetric, reactive. Reactive anti-aircraft threats go though search, acquisition, track reacquisitions, weapon launches, and flyouts in response to target aircraft. Countermeasure deployments and maneuvers are selected before run time, but repeater jammer and certain maneuvers are reactive.

LIMITATIONS: No geography, five DOF missile models, and limited multipaths.

PLANNED IMPROVEMENTS AND MODIFICATIONS:

1. Update existing threats to reflect latest intelligence and incorporate more robust ECCM;

2. Add new RED and BLUE threats, both airborne and ground based;

3. Incorporate ground clutter model for low altitude and lookdown airborne engagements;

4. Develop and incorporate corridor/stand-off chaff model;

5. Develop user analysis tools.

INPUT: Flexible, keyword-driven input routines with complete set of default values; tabular input.

OUTPUT: User selectable at many level. Principal outputs are missile miss distances at closest approach to aircraft and radar tracking errors.

HARDWARE AND SOFTWARE:

Computer:	Runs on VAX/VMS systems and UNIX-based workstations.
Storage:	Executable images generally about one MB.
Peripherals:	Terminal, printer, and graphics output (TEKTRONICS or emulator) device required to reach full potential of SCARE.
Language:	FORTRAN 77 plus supporting command procedures.
Documentation:	More than 11 user guides and 18 published reports.

SECURITY CLASSIFICATION: Unclassified; data classified up to Secret/NOFORN/ WNINTEL.

GENERAL DATA:

Data Base: Development of required input data from measurement programs and flight tests typically takes several man-months.

CPU time per Cycle: Depending on modules and complexity of engagement, typically runs 10 to 100 times slower than real time on micro VAX II.

Data Output Analysis: Postprocessors produce tabulated and plotted parametric studies.

Frequency of Use: Under continuous use by WL/AAWP-3 personnel; other users listed below.

Users: AFWAL/ENAMA, NWC China Lake, PMTC, NSWC, and WSMR. SCARE requested and used by AFWAL/AARM-3, AFEWS/SATR, ASD/ENANA, and others.

Comments: Maintains backward compatibility. New models continually added and models revised as new data is available.

TITLE: SCAT/ISCAT - Sea Control Analysis Tool and Interactive SCAT.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis (SCAT) and Training and Education (ISCAT).

PROPONENT: McDonnell Douglas Electronic Systems Company, Naval Studies and Modeling, 1801 E. St. Andrew Place, Santa Ana, CA 92705.

POINT OF CONTACT: Thomas Jacobs (714) 566-5916 or John Butler (714) 566-5917.

PURPOSE: SCAT models ASW encounters ranging from one-on-one sub vs. ASW sub, ship, or aircraft up to carrier battle force campaigns opposed by eight threat-submarines. SCAT is an analysis or research and evaluation tool that can assess competing weapons systems force mix, force tactics, or combat doctrine effectiveness.

ISCAT is an operator interactive or wargaming version of SCAT that inserts a man into the loop. Operators can control a Blue aircraft, ship, or submarine against a Red submarine for training (individual or team skills development) or tactics (new doctrine) development.

DESCRIPTION:
Domain: Full ASW at sea domain: air, sea, and undersea.

Span: Accommodates any ocean environment up to a transocean scenario, including subsurface and air.

Environment: Any ocean, acoustic regime and sea state.

Force Composition: Blue and Red submarines or ASW forces and C3I up to a carrier battle force or Red equivalent.

Scope of Conflict: Conventional and limited nuclear ASW.

Mission Area: Full ASW, including nonacoustics and Red/Blue pro-sub missions.

Level of Detail of Processes and Entities: Computes the Sonar Equation for any acoustic sensor (e.g., sonobuoy, shipboard or towed sonar, active or passive), through one or two acoustic environments, Red and Blue. Logistics, platform and sensor/weapons reliability and usage, and ASW C3I modeled. Non-acoustics simulated geometrically and/or with lookup tables.

CONSTRUCTION:
Human Participation: Operator interaction is available in ISCAT. Considerable reactive inputs allowed in scenario presets for Red and Blue C2 decisions and reactions based on tactical indicators are available in SCAT.

Time Processing: SCAT is dynamic, using event-steps. ISCAT is time-step.

Treatment of Randomness: SCAT is a stochastic, Monte Carlo model. ISCAT is a single Monte Carlo replication.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Eight or less threat submarines, one or two acoustic environments, basic C3I, national surveillance sensors treated only by product defined as a Statistical Probability Area (SPA). ISCAT operators can drive only one Blue and Red platform.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Adding a much more realistic C3I model to simulate comms delays, messages garbled or lost, and target tracking uncertainties; i.e., the "fog of war."

INPUT: Acoustic and non-acoustic sensor characteristics, oceanographic environmental conditions, red and blue force dispositions, tactics, aircraft allocation and basing, [illegible], and responsive tactics.

OUTPUT: Dynamic displays of combat kinematics and statistically analyzed data plots showing measures of effectiveness.

HARDWARE AND SOFTWARE:

Computer(OS):	Sun (SPARC), VAX, or CYBER.
Storage:	100,000 LOC.
Peripherals:	None required.
Language:	FORTRAN 77/UNIX.
Documentation:	User's manual and algorithm source document. Configuration control system using SUN software.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Up to three man-weeks for complex Battle Force Scenario.

CPU time per Cycle: Depends on data base size and player configuration. Typical Sun-based time to calculate one rep for complex scenario is 30 seconds.

Data Output Analysis: Display of combat kinematics allows verification of unit performance and tactics. Statistical data plots of Monte Carlo analysis show measures of effectiveness for warfare concepts.

Frequency of Use: Varies, but is used at least several times per year by those organizations listed below.

Users: Installed at Naval Air Systems Command (NAVAIR), Naval Air Development Center (NADC), Naval Surface Warfare Center (NSWC), and McDonnell Douglas. Several other Navy activities use the analysis including SPAWAR and NOSC.

Comments: Model is continually upgraded based upon customer requirements. All changes are managed by a configuration control board.

TITLE: SDISEM - Strategic Defense Initiative System Evaluation Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Coleman Research Corporation.

POINT OF CONTACT: Ernest Rider (407) 352-3700.

PURPOSE: SDISEM is a research and evaluation tool. It evaluates space-based strategic defense concepts and algorithms and focuses on the boost phase of SDI, but also has the capability to evaluate space-based boost, midcourse and terminal defense. The code was designed to evaluate the performance of fire control concepts and algorithms for alternative defensive architectures and offensive countermeasures. The simulation can adapt to a wide range of system architectures including brilliant pebbles (BP), rocket-launched kinetic kill vehicle (KKV), and hypervelocity gun (HVG) systems that have been considered by SDIO.

DESCRIPTION:

Domain: Space.

Span: Regional, local or individual.

Environment: Earth centered and local coordinate systems are used to compute object states. An atmospheric model based on the Atmospheric Research and Development Center 1959 (ARDC 59) model is used. It is a 13 breakpoint exponential fit to the atmosphere, producing pressure, density, and speed of sound data up to 700 km in altitude. Rotating earth is assumed with zero wind-earth relative velocity up to 200 km altitude.

Force Composition: Boost target trajectories are output from an external program and propagated through post-boost, midcourse and terminal phases by the simulation. Tracker platforms, weapon platforms, projectiles and battle management processors are simulated to the subsystem level.

Scope of Conflict: Blue-team space-based trackers and kinetic energy weapons (KEWs) defending against red-team ICBMs and SLBMs.

Mission Area: Full-scale attack (also known as the 'JCS mission'), Global Protection Against Limited Strike (GPALS), and all SDI-defined missions.

Level of Detail of Processes and Entities: Individual tracker platforms, weapon platforms and projectiles can be modeled, as long as 'groups' have the same parameters; the projectile seeker is also modeled.

CONSTRUCTION:

Human Participation: Not required; the model is not interruptable (must be restarted if interrupted); human participation is not permitted.

Time Processing: Model is dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo (with many deterministic processes).

Sidedness: One-sided, nonreactive.

LIMITATIONS: 200 threat boosters, from up to 3 launch fields. These are software-imposed constraints to keep run-times reasonable (they can be easily changed). SDISEM can have an appreciable run-times due to its high fidelity nature. A less detailed variation of the code, called Fire Control Simulation (FCSIM), is available for quick force-on-force simulations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Target mass properties, thrusts, drag characteristics, etc.; projectile stage mass properties, attitude control, guidance algorithm; weapon platform constellation size and orbital parameters; tracker platform parameters, tracker type (staring, scanning, etc.); attack management algorithm.

OUTPUT: Results are oriented to graphical summaries. Engagement statistics such as closing velocities, angles, miss distance, and intercept times, as well as any simulation variable.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX with a VMS operating system.
Storage:	Minimum of 8,000 blocks. 16,000 blocks should be configured when running the maximum simulation limits of 200 on 200. This corresponds to a system memory size of 8 MB.
Peripherals:	Terminal. Printer with graphics capability is useful for printing out .plt files.
Language:	VAX FORTRAN.
Documentation:	Extensively documented in four Version 2.0 published manuals (Analyst manual, User manual, Reference manual Volumes I and II).

SECURITY CLASSIFICATION: Unclassified, but input and output files may be classified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Scenario dependent (sim-time is about 1/2 real time).

Data Output Analysis: Postprocessors aid significantly in understanding the data. CRC proprietary graphical programs 'plotplus' and 'view' are used.

Frequency of Use: Several times per year.

Users: Coleman Research Corporation, Aeronautical Systems Division of Wright Patterson AFB.

Comments: SDISEM affords high fidelity simulation of target trajectories, fire control and end-game engagement. A distributed sensor option provides the capability to model and control sensors located on weapon platforms, rather than on a single fire control platform. Projectiles may be reassigned to new targets during the midcourse phase of flight.

TITLE: SEABAT - Sea Battle Model.

DATE IMPLEMENTED: 1979.

MODEL TYPE: Analysis.

PROPONENT: Studies, Analysis, and Wargaming Division (Code 64), Plans and Policy Directorate, Staff, CINCPACFLT, Pearl Harbor, HI 96860.

POINT OF CONTACT: Dr. Ray Runyan, (808) 474-8443, AV (315) 474-8443.

PURPOSE: SEABAT is an analysis model used for assessing the effects of RED force attacks on BLUE carrier battle forces. It is a research & evaluation tool that is used to assess force capability and requirements, particularly force mix within a carrier battle force and within attacking enemy forces.

DESCRIPTION:

Domain: Sea and air.

Span: Primarily local to the carrier battle force, with some regional activity also included.

Environment: Not considered explicitly. Environment may be reflected by choice of input values for some parameters.

Force Composition: BLUE carrier battle forces consist of a mixture of aircraft carriers, Aegis cruisers, single-ended and double-ended missile ships (CGs, DDGs, and FFGs), ASW combatants (DDs and FFs), and auxiliaries. Aircraft assigned to the battle force include fighters; attack aircraft; and ASW aircraft, including helicopters. RED forces include surface ships; several classes of submarines, including both missile and torpedo shooters; and bombers, jammers, and escort aircraft.

Scope of Conflict: Conventional.

Mission Area: Sea control (AAW, ASW, ASUW).

Level of Detail of Processes and Entities: SEABAT is an expected value model. Thus, ships, submarines, and aircraft are not represented individually. Results are expressed as noninteger numbers of entities. Events are treated sequentially, but specific times are not assigned to events. All entities are subject to attrition.

CONSTRUCTION:

Human Participation: Required for input only. However, once assessment of a series of attacks starts, it may not be interrupted.

Time Processing: Dynamic, event-step for sequential RED attacks on BLUE. Individual attacks are static.

Treatment of Randomness: Deterministic, generates values as functions of expected values.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Geography is not played. The model is essentially a RED-on-BLUE model, with limited capabilities for assessing BLUE-on-RED attacks.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Under consideration.

INPUT: BLUE and RED orders of battle, sequence and structure of events (mostly RED attacks), and performance characteristics (probabilities of detection, intercept, and kill, etc.; availability and reliability factors; parameters describing SAM launch cycles; etc.).

OUTPUT: Screen displays of tables showing expected numbers of forces lost and surviving for both RED and BLUE forces. Two levels of output detail are available: summary and expanded. Printed output is optional.

HARDWARE AND SOFTWARE:

Computer:	VAX systems (VMS).
Storage:	82 Kbytes (command file, executables, and typical data).
Peripherals:	Interactive terminal and optional printer.
Language:	VAX FORTRAN 77 (recoded from APL).
Documentation:	a) Center for Naval Analyses, A Sea Battle Model (U), CNA Research Contribution 373, April 1979, SECRET; b) Ketron, Inc., "Modification of SEABAT Program for CINCPACFLT's VAX 11/730 System," 21 November 1986, UNCLASSIFIED; and c) Ketron, Inc., "Status of the SEABAT Model on CINCPACFLT's VAX 11/730 System," 1 April 1988, UNCLASSIFIED. Documents (b) and (c) describe the evolution of SEABAT from a convoy defense model to a battle force defense model.

SECURITY CLASSIFICATION: Secret (unclassified upon removal of data statements).

GENERAL DATA:

Data Base: Default data base provided with model. Data base modifications are made interactively at the beginning of each model run. Time required depends on scope of modifications. Most modifications are made to force and attack structures and can be completed within minutes.

CPU time per Cycle: Seconds.

Data Output Analysis: Seconds.

Frequency of Use: Many times per year. CINCPACFLT uses SEABAT for its annual Capabilities Assessment, and CINCPAC uses it for analysis and war game BDA. SEABAT is also a supporting model for the CASES module of the Fleet Command Center Battle Management System.

Users: CINCPACFLT, CINCPAC.

Comments: Configuration managed by CINCPACFLT. Releases may be in the form of executable code and data base only.

TITLE: Seahunt.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: General Dynamics Undersea Warfare Center, 1525 Wilson Blvd., Suite 700, Rosslyn, VA 22209; General Dynamics Electronics Division, 5011 Kearny Villa Road, San Diego, CA 92123.

POINT OF CONTACT: Mike Walter, (703) 284-9208; Tom Augustine, (619) 573-7427.

PURPOSE: Seahunt evaluates the relative effectiveness of different ASW systems from a high-level perspective. It incorporates detailed behavioral models of submarine operations and their dependencies on external cueing as well as the ship's sensors. Areas of study have included various missile based ASW systems, battle group cooperative engagement, as well as submarine on submarine(s). Seahunt may be run in a 2-D or 3-D (solid body) graphics mode or in a nongraphics mode in which only results are displayed. The nongraphics mode provides for Monte Carlo analysis.

DESCRIPTION:

Domain: Sea and air, normally on an 800 Km x 800 Km grid.

Span: Theater to local.

Environment: Various acoustic parameters may be adjusted.

Force Composition: One target of interest, one primary pursuer, there may be interfering contacts.

Scope of Conflict: Conventional.

Mission Area: Open Ocean.

Level of Detail of Processes and Entities: Seahunt continues to evolve and mature as new weapon system concepts are explored and developed. The simulation models processes to the level of detail needed to capture their essence. Presently, submarine behavior is modeled to a high level of fidelity, acoustics are modeled using propagation loss equations and ray concepts, and communication processes are modeled by time delays.

CONSTRUCTION:

Human Participation: Not required. (Seahunt is interruptable.)

Time Processing: Dynamic (Event-Step).

Treatment of Randomness: Seahunt has stochastic as well as deterministic aspects. To obtain statistically significant results, the simulation may be run repeatedly in our Monte Carlo mode during which per run statistics are gathered. A Kalman filter algorithm is employed for some sensor and tracking systems, others use an optimized least-squared fit.

Sidedness: Two-sided, symmetric. (May also have interfering contacts.)

LIMITATIONS: As Seahunt continues to develop, it has proven itself to be a robust tool for displaying and analyzing new ASW concepts. Presently, we are not equipped to handle terrain, hardware-in-the-loop, or detailed structural or electronic engineering tasks. Seahunt is a systems level ASW design engineering tool.

PLANNED IMPROVEMENTS AND MODIFICATIONS: To be determined as the needs of the customer dictate.

INPUT: Extensive input file of variables that may be adjusted to modify the environment, weapons capabilities, platform performance, etc.

OUTPUT: 2-D or 3-D graphics, statistical files, or Monte Carlo results.

HARDWARE AND SOFTWARE:

Computer:	Tektronix XD88/30 workstation or Tektronix 4236 terminal supported by a SUN 3/260 (in essence, a UNIX-based system that has access to the STI graphics library).
Storage:	Depends on system being simulated.
Peripherals:	Color printer provided at Electronics Division
Language:	Kernigan & Ritchie 'C', graphics are from the Standard Tektronix Interface (STI) library supplied by Tektronix.
Documentation:	Programmer's Manual & User's Manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Usually less than a few minutes.

CPU time per Cycle: In graphics mode, the simulation usually requires 3-5 minutes to run, significantly less in nongraphics mode (per run).

Data Output Analysis: Varies, depending on the task.

TITLE: SEAT - Strategic Engagement Analysis Tool.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Los Alamos National Laboratory, A-5, Los Alamos, NM 87544.

POINT OF CONTACT: H.W. Egdorf, A-5 MS-F602, (505) 665-1087.

PURPOSE: SEAT is an AI-based analytic tool used to perform analysis of relocatable target acquisition, attack, and defense. This research and evaluation tool deals with weapons systems, systems effectiveness, force capability and requirements, and combat development.

DESCRIPTION:

Domain: Land and air.

Span: Variable regional areas (primarily Soviet Union).

Environment: A rail network. The projected environment includes a digitized road network, elevation, weather, forestation, and day/night.

Force Composition: BLUE attacker and RED target set.

Scope of Conflict: Conventional nuclear weapons. The projected scope of conflict includes special nuclear weapons and conventional weapon effects.

Mission Area: Target acquisition, detection, attack, and defense. Transportation activities.

Level of Detail of Processes and Entities: The operational tactics for SRTs and BLUE C3 are portrayed as well as the physical characteristics and employment strategies of the target acquisition (sensors) and weapon entities. Entities that participate in an engagement include a RED regiment C3 and RED battalions (each battalion consists of three launchers and command post) in the target subsystem; aircraft, satellites, and df-nets in the target acquisition subsystem; BLUE C3; weapons; BLUE search and attack; and terrain.

The simulation uses an event-driven architecture for observing and queuing sensors, firing weapons, BLUE searching and attacking, and moving targets. The appropriate military command structure of SRTs was also modeled. Targets can fire upon armed reconnaissance units. Targets that have been killed are removed from the simulation and used weapons are also depleted. Parameterized variables support the probability-of-kill attrition determination. If planes have finished their flight plan, they are not used in the simulation until they are ordered on another reconnaissance mission.

CONSTRUCTION:

Human Participation: Required for input scenario specification. Human participation is permissible via module interruptability.

Time Processing: The model is dynamic with both time-step and event-step.

Treatment of Randomness: Has both stochastic and deterministic facets. Stochastic portions use direct computation instead of Monte Carlo techniques. Deterministic portions have no randomness.

Sidedness: Two-sided, asymmetric, event-driven model. Can be used by a single analyst.

LIMITATIONS: Does not model all C3I functions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Terrain representation will be enhanced to include a road network, weather, elevation, forestation, and day/night. Additional weapons effects, C3 functions, and train generators will be included in future versions.

INPUT: The scenario subsystem is very flexible and provides easy access for the analyst to modify scenario data values. Data values include terrain, weapons, movement, attrition tables, and unit characteristics. Changing decision rules requires programmer assistance.

OUTPUT: Full graphics, real-time representation of situation and activities including movement, acquisition, attrition, communication, and logistic data.

HARDWARE AND SOFTWARE:

Computer:	Runs on the Symbolics 36XX computers.
Storage:	.5 Megabytes.
Peripherals:	1 printer.
Language:	LISP, Knowledge Engineering Environment, FORTRAN.
Documentation:	User manual.

SECURITY CLASSIFICATION: Unclassified, but data bases and knowledge bases are classified.

GENERAL DATA:

Data Base: Terrain data base is time and data intensive. Other data bases are easily constructed. Cognitive aspects of knowledge bases require special planning, programming, and handling.

CPU time per Cycle: Near real-time depending upon analyst desires.

Data Output Analysis: N/A.

Frequency of Use: At Los Alamos several times per year and supports other appropriate organizations in joint and cooperative studies.

Users: Los Alamos National Laboratory.

Comments: A first analysis product developed from an earlier prototype. Design of the tool provides the capability to perform analysis on many other applications. Therefore future simulations can be run representing buried targets or a new type of weapon in addition to the currently defined mobile system (SS-24s). The menu-driven interface allows for future integration of software modules as they become available.

TITLE: SEES - Security Exercise Evaluation Simulation.

DATE IMPLEMENTED: 1987 (latest version March 1991).

MODEL TYPE: Depending on the needs of its users, SEES is being used for both analysis and training and education.

PROPONENT: Conflict Simulation Laboratory, Lawrence Livermore National Laboratory, P.O. Box 808 L-315, Livermore, CA 94550.

POINT OF CONTACT: Dr. Ralph Toms, (510) 423-9828.

PURPOSE: SEES has been used as a research & evaluation tool to evaluate the effectiveness of new weapons systems and new tactical doctrines. It is being used as a training tool for commanders of secure sites.

DESCRIPTION:

Domain: Land with limited air and naval operations.

Span: Largest use was for drug interdiction exercises over an 80 kilometer square area. Smallest use for site security training and analysis in a 400 meter square area.

Environment: Rectangular grid for elevation data. Feature data is overlaid on top of the terrain grid in the form of tiles or vectors. Features include rivers, roads, foliage, buildings, fences, and walls. Building interiors are explicitly modeled. Weather is variably defined but constant during duration of play. Day operations only.

Force Composition: Small conventional or unconventional forces. Blue and Red.

Scope of Conflict: Conventional warfare, unconventional warfare, and special operations. All data is external and editable by the user so virtually any imaginable conventional weapon may be modeled without the necessity to modify source code.

Mission Area: Both conventional and unconventional warfare has been modeled. Models air-to-ground and ground-to-air combat. Models air-to-air for rotary-wing aircraft only.

Level of Detail of Processes and Entities: Individual game units can represent from one to fifteen item systems. There can be up to 500 units per side. Orders and plans are given at the game unit level. Line-of-sight and acquisition is also done at the unit level. All other combat processes are done at the item system level. Attrition is done via probability of hit and kill, Monte Carlo based, and adjudicated at the item system level.

CONSTRUCTION:

Human Participation: Required to enter initial plans and orders. SEES can be run in systemic mode without human participants for analysis or it can be run in interactive mode with humans interacting and changing plans at real time.

Time Processing: Dynamic, event-stepped. During interactive play SEES is slowed down so that it runs at no faster than real time.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric. Whether or not forces react depends on whether or not the force has a human player assigned to it. Can be operated with no players (systemic mode), a single player, or as many as 16 players.

LIMITATIONS: Limited to 500 units per side, 15 item systems per unit. Maximum terrain resolution is 400 x 400 terrain cells (40 km square at 100 meter resolution, 400 m square at 1 meter resolution). Does not model air-to-air combat for fixed wing aircraft. Does not model undersea operation nor some aspects of ship-to-ship fighting.

PLANNED IMPROVEMENTS AND MODIFICATIONS: New, faster algorithms are being developed to allow larger games to be played. Looking at migrating to RISC/UNIX with X-WINDOW systems.

INPUT: All modeling data is external to the model. This includes all weapon and platform characteristics, PH/PK data, terrain, force organization, and force orders and plans. Even the graphic symbology used may be modified by the user.

OUTPUT: Produces formatted status and loss reports. Also produces event history files which can be used with the Analyst Workstation postprocessor to analyze the results of the game and to create after action reviews. The history file includes movement, combat and attrition, logistics, and intelligence information.

HARDWARE AND SOFTWARE:

Computer:	Will run an any VAX computer with the VMS operating system.
Storage:	80,000 blocks for the SEES software itself. 300,000 blocks for users.
Peripherals:	Minimum requirement for analysis: 1 printer, 1 VT-100 compatible terminal, 1 Tektronix 4225 workstation with 4 MBytes of memory and one graph tablet. Add a second 4225 for training. A full-up system has 8 Tektronix 4225 with two graph tablets each.
Language:	VAX FORTRAN, DCL. INGRES is optional.
Documentation:	Extensively documented with 7 published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Initial data bases may take several man-weeks.

CPU time per Cycle: Highly dependent on scenario size and computer speed. Company size scenarios typically run faster than real time and have to be slowed down if there are human interactors.

Data Output Analysis: Analyst Workstation (AWS) postprocessor allows after action review within minutes of game completion. Statistical analysis using AWS and provided relational data base may be completed in a few hours.

Frequency of Use: Depends on the individual users. Some use it daily, others weekly, the rest use it on a monthly or quarterly basis.

Users: Lawrence Livermore National Laboratory, Department of Energy Central Training Academy, SOUTHCOM, USA Europe 7th ATC, Berlin Brigade, Fort Lewis, USA TRAC Monterey, USMC Warfighting Center, USMC Wargaming Center.

Comments: Managed by Lawrence Livermore National Laboratory which also sponsors an annual Users Group meeting. Continually upgraded based on user needs.

TITLE: SFEM - Space Forces Engagement Model.

DATE IMPLEMENTED: February 28, 1991.

MODEL TYPE: Analysis.

PROPONENT: HQ Air Force Space Command/CNS.

POINT OF CONTACT: Dr. Al Bevan, (714) 554-6804 or AV 692-6804.

PURPOSE: Research and Evaluation Tool. Useful for weapon systems development, systems effectiveness, force capability and requirements, mix effectiveness and resource planning.

DESCRIPTION:

Domain: Land, sea, air, and space.

Span: Global.

Environment: Oblate rotating earth, nuclear antisatellite effects on satellite targets, no atmosphere.

Force Composition: Uses mobile or fixed, land, sea, air and space based antisatellite weapon systems.

Scope of Conflict: Red and Blue conventional and nuclear weapons.

Mission Area: Space control using antisatellite weapons and maneuver, decoy, and sabotage defenses.

Level of Detail of Processes and Entities: Entity: Individual missiles and targets. Processes: Models both sides of conflict using the functional areas of weapons, battle management, command & control, communications, and surveillance.

CONSTRUCTION:

Human Participation: Not required and not permitted.

Time Processing: Dynamic event-stepped.

Treatment of Randomness: Runs either stochastic or deterministic: 1. Monte Carlo; 2. Basically deterministic.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Number of weapons and targets are limited only by dimension statements, speed of computer, size of computer memory, and practicality. Messages are limited to 32 types but unlimited numbers within those types.

PLANNED IMPROVEMENTS AND MODIFICATIONS: As required.

INPUT: Simulator is data base driven. All inputs must be entered into the data base characterizing weapon systems, surveillance systems, battle management, command & control, communication nodes, and message types and paths. Scenario data must also be input.

OUTPUT: Input menu screen printouts, log event output printouts, data reports, terminal displays.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/785 or Microvax with VMS operating system.
Storage:	20 Megabytes.
Peripherals:	Printers and graphics plotters.
Language:	VAX Fortran.
Documentation:	User's Manual, Algorithm Description Document, and Production Specifications.

SECURITY CLASSIFICATION: Unclassified except for one optional module that is needed when nuclear effects are simulated.

GENERAL DATA:

Data Base: Hours to days depending on complexity and extent of scenario and systems being simulated.

CPU time per Cycle: Minutes to hours.

Data Output Analysis: Hours to days.

Frequency of [illegible] Daily.

Users: Air Force Space Command, Air Force Systems Command/Mitre, and Naval Surface Warfare Center.

Comments: A number of software programs have been written at HQ AFSPACECOM for postprocessing the log-event output file.

TITLE: SHIPDAM - Ship Damage Model.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education.

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: SHIPDAM models ship damage caused by weapons hits. It is designed to support battle damage assessment in conjunction with larger war games or other micromodels.

DESCRIPTION:

Domain: Sea.

Span: Local.

Environment: N/A.

Force Composition: Individual ship, enemy antiship weapons.

Scope of Conflict: Conventional antiship weapons.

Mission Area: N/A.

Level of Detail of Processes and Entities: User defines target ship, type and number of impacting weapons, and azimuth of weapon approach.

CONSTRUCTION:

Human Participation: Required for initial inputs only.

Time Processing: Closed form.

Treatment of Randomness: Outcomes stochastically based on direct computation of probabilities, with Monte Carlo determination of result.

Sidedness: N/A.

LIMITATIONS: Can only be run for ship classes for which data sets have been constructed by David Taylor Research Center.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Additional data sets, incorporation of personnel casualties.

INPUT: Target ship, type and number of impacting weapons, and azimuth of weapon approach.

OUTPUT: Data files containing exact burst point location for each hit, status for ship components and systems, and hit-by-hit report.

HARDWARE AND SOFTWARE:

Computer: IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: N/A.
Language: "C."
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Unclassified, but data bases are classified.

GENERAL DATA:

Data Base: 10 minutes.

CPU time per Cycle: 20 seconds.

Data Output Analysis: N/A.

Frequency of Use: Several times per year.

Users: Wargaming Department, Naval War College.

Comments: SHIPDAM is called by the Surface-Air Battle model. The original model was designed by the David Taylor Naval Ship Research and Design Center and is based on the mainframe-based Ship Vulnerability Model at DTNSRDC.

TITLE: SIDAC - Single Integrated Damage Analysis Capability.

DATE IMPLEMENTED: 1st operational capability June 30, 1974.

MODEL TYPE: Analysis.

PROPONENT: Defense Information Systems Agency (DISA), Defense Systems Support Organization (DSSO), Washington, DC 20301-7010.

POINT OF CONTACT: Mr. Richard Webb or Ralph Mason (703) 693-5882.

PURPOSE: SIDAC consists of a number or mathematical models and associated numerical routines which efficiently calculate the effects of nuclear weapons on specified targets. SIDAC has a generalized capability designed to give a high degree of flexibility in solving damage assessment problems for a diverse range of user requirements. SIDAC is designed to meet special user requirements by providing exit points at strategic program locations, which enable the user to alter standard processing by adding routines to the SIDAC model. SIDAC calculates both prompt (blast, initial radiation and thermal radiation) and residual (fallout) effects.

DESCRIPTION:
Domain: Resources on and below earth's surface.

Span: Global.

Environment: Data bases using DIA's Physical Vulnerability numbers, upper level winds for fallout transport and times of detonation.

Force Composition: Nuclear forces.

Scope of Conflict: Nuclear weapons (red, blue or mixed).

Mission Area: Normally strategic.

Detail of Level of Processes and Entities: Any level of confrontation from a single detonation to complete all out nuclear.

CONSTRUCTION:
Human Participation: Not required. Retraction reports permitted to undo the effects of a previous reported detonation.

Time Processing: Dynamic - time of detonation is part of input weapon report.

Treatment of Randomness: Normally deterministic (expected value) however special output can be provided which treats process stochastically (Monte Carlo).

Sidedness: Model is color blind (i.e., a nuclear weapon affects all resources within its reach - red or blue).

LIMITATIONS: Only surface and underground resources processed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: SIDAC will be ported and installed on workstation size machines (Silicon Graphics and SUN).

INPUT: Nuclear weapon characteristics (yield, fission yield, height of burst, CEP, arrival probability); winds at seven standard pressure heights; assessment locations (targets) with associated vulnerability numbers (JRAD, TDI and other standard formatted data bases).

OUTPUT: Users produce his/her own format of outputs. A Handbook (TM 154-81) of sample outputs has been published as an aid to the users. TM 154-81 includes sample printer outputs, plots and listing of statistically analyzed data.

HARDWARE AND SOFTWARE:

Computer: IBM 4341/3033/3090 (OS, CMS, MVS, etc.); HIS 6080 (GCOS 8); Data General MV 10000 or MV 4000 (AOS/VS).

Language: Mainly FORTRAN.

Documentation: Extensively documented; the main system documents are SPM FD 7-73; CSM UM 67-79; SPM pt 7-73; TM 15-80; TM 91-84; SPM RT 7-75; TM 154-81. Documentation available from DISA/DSSO/JN3V or the Defense Technical Information Center, Cameron Station, Alexandria, VA 22304-6145.

SECURITY CLASSIFICATION: Confidential, but data inputs are often at a higher classification.

TITLE: SIFT - Selectively Improved Flagging Technique.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Flagging Division, Electronic Warfare (EW) Directorate of Operations, Air Force Electronic Warfare Center, HQ Electronic Security Command, San Antonio, TX 78243-5000.

POINT OF CONTACT: AFEWC/EWFE, DSN 969-2021; Commercial (512)977-2021.

PURPOSE: SIFT is used to analyze the capabilities of reprogrammable EW systems. It is primarily designed as a tool to evaluate EW system responses against specific threat scenarios, but can also be used as an aid to tactics and reprogramming decision making. Currently partial models of the ALR-69(F-16) and ALR-46V4(B-52) are operational. Models of the ALR-62I(F-111/FB-111), ALR-56A(F-15), ALR-56C(F-15), ALR-56M(F-15) and ALQ-135 Band 3(F-15) are under development and all should be operational by Summer 92.

DESCRIPTION:

Domain: The simulation is designed to accept any realistic set of digitized radio frequency (RF) data from land, sea or air.

Span: Model is designed to test effects of the environment against a single aircraft. Input data is naturally restricted to what can be physically seen by the EW system at any instant in time. Tools are under development to allow user creation of "what if" scenario testing environments.

Environment: A simulated aircraft position (latitude and longitude) and surrounding RF environment is input to the model. A two dimensional analysis which neglects terrain relief and emitter altitudes and assumes a straight and level flight is accomplished. The EW system response based on aircraft position and emitter environment is provided. User selectable choices simulating cockpit button activation are provided (e.g., priority, training, altitude).

Force Composition: Selection of either red or blue/gray emitters are allowed.

Scope of Conflict: The model is designed to evaluate capability of the single EW system under test. No handshaking or data passing effects are taken into account. Input data sources outside the RF regime of the EW system capabilities are logged and ignored.

Mission Area: Any environment in which an aircraft might be expected to fly.

Level of Detail of Processes and Entities: The model simulates the hardware functions of the EW system and emulates operation of the EW system Central Processing Unit (CPU) onboard the aircraft. The actual Operational Flight Program and accompanying emitter data base files are downloaded directly into the model. The maximum detectable range radius and receiver bandwidth are both included within the analysis. No statistical calculations are necessary for operation of the system. Software results include the symbol response, if any, and an audit trail of data usage.

CONSTRUCTION:

Human Participation: The user selects initial conditions and starts the model in either a batch (noninterruptable) or debug (interruptable) mode.

Time Processing: Input pulse-level data is arranged in time ascending order. The model processes until the input data is exhausted. The aircraft is held at a stationary position and a "time-slice" of input data is processed.

Treatment of Randomness: None.

Sidedness: One-sided model.

LIMITATIONS: The ALR-69 and ALR-46v4 provide only an initial symbol display (i.e., ambiguous displays are not further "resolved" by the system). Some EW hardware simulations are modeled at a fairly high level. In these cases the process has been simplified to clearly defined "yes/no" decision logic.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The ALR-69 and ALR-46v4 are anticipated to be upgraded to include all processing within the system. Tools to assist in building of emitters and scenarios are in development. Optionally, the user can set simulated aircraft EW system characteristics to specified values.

INPUT: Model requires input to include the time-of-arrival, RF, pulse width, amplitude and geolocation of every pulse from each emitter.

OUTPUT: Produces a file summarizing the input data stream along with indications of how each and every pulse was used within the model. Included are some of the significant parameters generated during the data run.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a SUN computer with a UNIX operating system.
Storage:	Model executable(250k), pulse files(30k/file).
Peripherals:	1 printer.
Language:	FORTRAN, C and ADA.
Documentation:	User guides included for all models. All source code well documented.

SECURITY CLASSIFICATION: SECRET/NOFORN.

GENERAL DATA:

Data Base: Creation of scenarios and new test cases are currently manually intensive. Tools under development will significantly simplify process.

CPU time per Cycle: System executes at about 1/100 the speed of the actual CPU when hosted on a 10 MIPS machine.

Data Output Analysis: Main purpose of model is to provide diagnostic information of results from the execution. Output contains the RWR symbol presentation and audit trail of input data. Knowledge of EW system's operation required to interpret some of the results.

Frequency of Use: Varies by command, but is used at least daily within AFEUC/EWF.

Users: ESC, USAFTAWC, SAC, MAC.

Comments: Managed through AFEWC/EWF. Upgrades based on software block cycle updates and operational EW hardware changes.

TITLE: SIM - Sensor Interaction Model.

Date Implemented: 1 January 1992.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Materiel Systems Analysis Activity (USAMSAA), Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: Mr. Schoeb, (301) 278-6431, DSN 298-6431.

PURPOSE: SIM is used to characterize the performance of individual or suites of sensors against specified threat scenarios.

DESCRIPTION:

Domain: Land, air and space.

Span: Regional.

Environment: Terrain, weather, obscurants and time of day.

Force Composition: Combined forces, RED and BLUE with various unit sizes possible.

Scope of Conflict: Conventional.

Mission Area: Red sensors on Blue targets or Blue sensors on Red targets.

Level of Detail of Processes and Entities: Individual vehicles, aircraft, radios, radars, jammers.

CONSTRUCTION:

Human Participation: Needed to specify unit movement and radio and radar on/off-times.

Time Processing: Dynamic, has both time and event sequencing.

Treatment of Randomness: Stochastic and/or deterministic.

Sidedness: One-sided.

LIMITATIONS:

- Large computer storage requirements)
- Slow run time) for medium to
- Extensive effort to build scenarios) large scenarios

PLANNED IMPROVEMENTS AND MODIFICATIONS:

- Transfer target model to UNIX/x-window environment.
- Add fusion and process flow model to sensor model output.
- Menu/window based utility to aid scenario generation.
- Add additional sensors.
- Sensor cross cueing/retasking.

INPUT: Terrain data; Unit definitions. Entity characteristics: vehicles, aircraft, sites, radios, radars, jammers, weapons. Unit deployment patterns. Radio network distributions. Unit movement and radio/radar on/off-times. Meteorological conditions. Sensor performance characteristics.

OUTPUT: Ground truth; Sensor reports.

HARDWARE AND SOFTWARE:

Computer: VAX 11/785(VMS); VAX Station II/GPX (VMS); Silicon Graphics 4D25 (UNIX).

Storage: 250/70 M (scenario dependent).

Peripherals: Disk storage, printer.

Language: VAX assembly; PASCAL; [illegible]L (PASCAL like software compiler); FORTRAN; C; C ++.

Documentation: Available for each of the component sub models included in SIM.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: 3 man-months for Soviet combined Arms Army.

CPU time per Cycle: Scenario generator: 50 sec (Soviet combined Arms Army, 1 sec of combat, VAX 11/785). Sensor model: 1 sec (Soviet Combined Arms Army 10 sec of combat, VAX 11/785).

Data Output Analysis: 1 man-month.

Frequency of Use: Continuously.

Users: USAMSAA.

Comments: SIM consists of a variety of new and existing models integrated into one package.

TITLE: SIM II.

DATE IMPLEMENTED: 1974.

MODEL TYPE: Analysis.

PROPONENT: Naval Underwater Systems Center; Modeling & Simulation Division (Code 61), New London, CT 06320.

POINT OF CONTACT: Dr. Jeffrey S. Cohen (Code 61); Comm: (203)440-5998; A/V: 636-5998.

PURPOSE: SIM II is used primarily to analyze ASW engagements (both one-on-one and many-on-several) at the platform level. It has been used to assess the effectiveness of ASW combat/weapon systems as well as to perform system level engineering trade-offs based on performance. Detailed models of the environment, ship and system characteristics, and tactics are exercised. It has also been used to plan exercises and extend the applicability of Fleet measurements.

DESCRIPTION:

Domain: Undersea Warfare; submarine, surface and air ASW.

Span: Local, multi-ship engagements; time duration usually measured in hours or days.

Environment: Usually time- and range-independent inputs of underwater acoustic propagation loss and reverberation, background noise (ambient and shipping).

Force Composition: Blue submarine, surface ship and/or air platforms, fixed surveillance, land-based command and control centers; red submarines, surface ships and air platforms, neutral shipping, usually as interfering noise sources.

Scope of Conflict: ASW weapons (conventional and nuclear) and countermeasures.

Mission Area: Primarily ASW, offensive and defensive.

Level of Detail of Processes and Entities: Individual systems aboard ship are modeled including sonar (detection, classification, tracking), combat control systems (targeting) and weapon systems (search, acquisition, guidance and control, homing, damage effects nuclear), countermeasures--both weapon and sonar, vehicle dynamics (turn rates, dive rates, acceleration rates), communications and electromagnetic systems. Tactical decisions are made based on computed data as perceived aboard ship based on measured and/or theoretical error distributions.

CONSTRUCTION:

Human Participation: Allowed but not required. Reactive tactics are modeled, based on calculated, noisy data as perceived aboard ship, through a detailed, rule-based tactics language.

Time Processing: Dynamic, variable time-stepped/event driven.

Treatment of Randomness: Monte Carlo stochastic model; initial geometries randomized based on user controlled distributions; long term signal-to-noise fluctuations are Gauss-Markov; short term detection fluctuations are Log-Rayleigh.

Sidedness: Blue, red and neutral forces. Tactics are defined for each ship and are fully reactive. Red systems and tactics are modeled as defined by intelligence sources--not mirror imaged.

LIMITATIONS: Engagement as opposed to theater level campaign.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements are driven by study requirements. Current studies are emphasizing low frequency active, towed array targeting, weapon and sonar countermeasures. Hence, additional detail will be added in these areas. Continually increase efficiency through the use of graphic user interfaces, automated data bases and input/output support software.

INPUT: Ship, system, environment and tactics must be specified for each ship in the simulation. Automated data bases for standard combinations exist.

OUTPUT: Output at various levels of detail are stored on disk and can be printed, plotted and statistically analyzed by the user. Standard measures of effectiveness are exchange ratio, weapon system effectiveness and search rate as well as detection, classification, targeting, attack/reattack and kill probabilities, ranges and times.

HARDWARE AND SOFTWARE:

Computer:	Network of CRAY X/MP-28, SILICON GRAPHICS IRIS and SUN workstations (all UNIX operating system) and VAX 8800 (VMS).
Storage:	2 - 6 MB memory; 1 - 2 GB mass storage.
Peripherals:	Standard terminals, printers, plotters.
Language:	ANSI FORTRAN.
Documentation:	Five Volume Manual plus supporting reports.

SECURITY CLASSIFICATION: Unclassified, but data bases and corresponding outputs are usually at the secret level.

GENERAL DATA:

Data Base: Many standard data sets are available and can be modified rapidly. Development of new, large scale data bases may take weeks, but more time is required to gather acceptable/approved data than is needed to enter it in the data base.

CPU time per Cycle: Depends on size and complexity of case, but usually runs 100's - 1000's of times faster than real (simulated) engagement time per iteration.

Data Output Analysis: Automated analysis tools for statistical analysis and generation of graphic outputs such as track charts, bar graphs/histograms, color transparencies.

Frequency of Use: Used continuously at NUSC with several major studies being processed simultaneously.

Users: Approximately 50 trained users at NUSC (and supporting contractors), 15 with more than 10 years experience. Frequent study sponsors include NAVSEA, SPAWAR, OPNAV, OPTEVFOR and DOT&E.

Comments: Program is rigorously managed with documented software and documentation standards, undergoes frequent independent reviews, both internally and externally. Carefully documented, continuously compared to at-sea data for validation purposes. Optimized for efficiency and productivity on the NUSC Integrated Warfare Analysis Laboratory.

TITLE: SIMFORCE.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: U.S. ACDA, CACI Proprietary Model.

POINT OF CONTACT: Dr. Glen H. Johnson, U.S. ACDA, Operations/Analysis Group, 320 21st St. NW, Washington, DC 20451, (202) 647-4695.

PURPOSE: SIMFORCE is a static model of conventional force capability. It allows quick analysis of force on force capability using weapon counts and scoring schemes such as WEV/WUVs, OLI, or other measures. It accounts for terrain type, weather, usable terrain, and other factors that could affect the force balance. It allows quick analysis of conventional arms control options that focus on limiting the number of different weapon types.

DESCRIPTION:
Domain: Land Operations.

Span: Accommodate any theater. Data currently available for the European Central Region.

Environment: Uses static scores by specified regions or frontal areas.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Conventional force evaluations only.

Mission Area: Conventional missions only.

Detail of Level of Processes and Entities: Ground Units are specified at the regiment level. Regiments are assigned to sectors. Force on force scores can then be computed by sectors or geographic region. These scores can be output in tabular form or displayed in one of several graph types provided by the model.

CONSTRUCTION:
Human Participation: Not required; not permitted.

Time Processing: Static.

Treatment of Randomness: Basically Deterministic.

Sidedness: Two-sided; symmetric.

LIMITATIONS: Does not account for force balance after fighting begins.

INPUT: Unit TO&E, static scores for each weapon, regions, terrain data, weather data, command structure, units, posture, and negotiation class.

OUTPUT: Tabular data and several types of graphs.

HARDWARE AND SOFTWARE:
Computer: 80386 PCs and SUN Workstations.
Storage: Approximately 5 megabytes.
Peripherals: Supports most printers and plotters.
Language: Written in SIMSCRIPT.

SECURITY CLASSIFICATION: Unclassified without data.

GENERAL DATA:

Data Base: Requires about 2 man days to input.

CPU time per Cycle: 3 Seconds.

Data Output Analysis: Produced in real time.

Frequency of Use: As required. Model used to generate rough counts of force capability.

Users: U.S. ACDA, other DOD and CIA organizations have obtained the model for evaluation.

TITLE: SimMaster.

DATE IMPLEMENTED: 1987.

MODEL TYPE: N/A. SimMaster is not a single model. Instead, it is a simulation model development system for rapidly building all types of discrete-event, as well as continuous, military simulation models. Both "analysis" and "training and education" models can be built with SimMaster.

PROPONENT: United Technologies Corp., Advanced Systems Division.

POINT OF CONTACT: Dr. Ronald Painter (619-535-5693), United Technologies Corporation, Advanced Systems Division, 10180 Telesis Ct., San Diego, CA 92121; FAX: 619-535-5757.

PURPOSE: SimMaster is an object-oriented simulation environment that provides the building-blocks to rapidly develop discrete-event simulation models of military systems for a wide range of combat scenarios. It also has the capability of producing continuous and combined discrete/continuous simulations. SimMaster uses Simscript II.5 with Simgraphics as a base simulation language. On top of this base, it has its own primitive simulation constructs consisting of objects, nodes, links, messages, and monitors. SimMaster simulacion models are constructed from these object-oriented build-blocks. SimMaster's Radiation Monitor and Generic Transmitter/Receiver Node provide built-in capabilities for representing the electromagnetic environment. Its Motion Monitor and Intercept Monitor provide built-in capabilities that support a wide range of combat entity dynamics.

SimMaster can be used to develop simulations that support analysis, as well as training and education. In its analysis support role, SimMaster models can provide insight and supporting data for: 1) weapons systems development alternatives, 2) weapons systems effectiveness issues, 3) force courses of action assessment, 4) force mix assessment, 5) force effectiveness studies, 6) force resource planning, 7) combat doctrine development, 8) combat strategies assessment, and 9) combat policy evaluation. In its training and education role, SimMaster models can be constructed to support skill development, as well as supporting various types of exercises such as field training.

DESCRIPTION:

Domain: SimMaster simulation models can be built to represent a wide variety of physical and abstract space, including land, sea, air, space, a combination of the previously mentioned domains, or some abstract domain.

Span: The scale of SimMaster models can range from global, theater, regional, local, to individual, or any combination thereof.

Environment: Environmental factors such as weather, sea states, terrain, time-of-day, and electromagnetic radiation can be accommodated in SimMaster simulations. SimMaster's Radiation Monitor and Generic Transmitter/Receiver Node provide built-in capabilities for representing the electromagnetic environment.

Force Composition: The mix of forces that can be represented in SimMaster simulations includes any combination of element, component, joint, or combined forces.

Scope of Conflict: SimMaster's building-blocks can be used to develop combat models, including both red and blue players, for conventional, unconventional, chemical, biological, nuclear, special, and rear-area warfare types.

Mission Area: SimMaster models can support any recognized combinations of weapons and procedures used to accomplish specific objectives such as sea control, close-air-support, airlift, command and control, and indirect artillery.

Level of Detail of Processes and Entities: SimMaster building-blocks can accommodate both highly arrogated, as well as highly detailed models, or model components, of real-world entitles and processes.

CONSTRUCTION:

Human Participation: The SimMaster modeling environment includes the User Interface Monitor. This SimMaster building-block facilitates a wide range of user interaction with various stages of the simulation. Its use is not required. SimMaster simulations can be setup to run without any human participation. But if desired, human participation can be readily accommodated in a SimMaster simulation.

Time Processing: SimMaster models are properly characterized as being message driven because the actions in the simulation are primarily based on the message traffic among SimMaster's object-oriented node constructs. When SimMaster building blocks are translated to their Simscript II.5 equivalent, then the simulations can be viewed as process or event-stepped.

Treatment of Randomness: SimMaster supports both determinist and stochastic simulations. Built-in capabilities facilitate stochastic simulations. These capabilities include pseudo-random numbers, several common distributions, as well as statistical analysis aids.

Sidedness: SimMaster building-blocks can be used to construct both one-sided and multi-sided simulations that can be either symmetrical or asymmetrical (combinations of reactive and/or nonreactive sides).

LIMITATIONS: SimMaster uses Simscript II.5 as a base, general purpose, simulation language. SimMaster thereby inherits all the benefits and limits of Simscript.

PLANNED IMPROVEMENTS AND MODIFICATIONS: SimMaster is a mature and well documented discrete-event simulation development system. There is an active research and development program to continue to enhance SimMaster's generic simulation development capabilities as well as to add specific military modeling capabilities, such as a generic track-while-scan capability.

INPUT: Standard and user-defined data bases which include RCS data, terrain data, types data, user data, Pk data, aero data, and road data.

OUTPUT: Outputs are typically collected in files (data bases such as object-state data and statistical data) which are used for postprocessing data analysis. Run-time output can also be viewed on text or graphics monitors, or be redirected to a printer.

HARDWARE AND SOFTWARE:

Computer:	SimMaster can be operated from any Simscript II.5 supported platform. This includes main-frames (IBM, etc), minicomputers (VAX/VMS, etc.), UNIX workstations, DOS and OS/2 PCs, and UNIX Macs.
Storage:	SimMaster's common building-block software requires just under 2MBs of storage. Additional storage depends on the size of the simulation being built. Typical additions range from 2 to 5 MBs.
Peripherals:	Depending on the mode of operation, required peripherals include a keyboard, a text and/or graphics monitor, and a printer.

Language: Simscript II.5 with Simgraphics; SimMaster's own simulation building-blocks consisting of generic nodes, the framework, the monitors, data bases, and support routines .

Documentation: Extensively documented; documentation guidelines specify sets of documents to be produced for each SimMaster simulation model.

SECURITY CLASSIFICATION: SimMaster's common software building blocks are unclassified; need for anything other than an unclassified rating would be data driven.

GENERAL DATA:

Data Base: The time needed to prepare the data bases for SimMaster simulation model depends on the complexity of the model. Generally, data bases for simple models can be prepared in a time range of from 30 minutes to 2 hours. Complex simulation data setup might take as many as 6 hours.

CPU time per Cycle: Depends on the complexity of the particular SimMaster model. Fast-time simple models may run in less than 5 minutes. Complex models could run for 72 hours or more.

Data Output Analysis: Built-in facilities, including graphics animation, are available to aid output analysis. Actual time spent depends on the complexity of the model. Output analysis for most models will fall into a time range of between 30 minutes to 8 hours.

Users: SimMaster simulation models have been built for Navy, Army, and Air Force applications. These models include 1) advanced Helicopter (LH) simulations, 2) simulations for the Canadian Tribal Frigate Modernization Program, 3) glide weapon systems simulations, 4) simulations for Theater Missile Defense Architecture Studies, and 5) simulations for a Millimeter Wave Missile Program.

Comments. SimMaster is kept under strict configuration control using Apollo's Domain Software Engineering Environment (DSEE) automated configuration control tool. Changes (corrections, upgrades, etc.) to SimMaster must be approved by the SimMaster Configuration Control Board.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SINBAC - Systems for Integrated Nuclear Battle Analysis Calculus.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Strategic nuclear analysis.

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Room 1D937, Washington, DC 20318-8000.

POINT OF CONTACT: Mr. Dale Peters, (703) 695-0859, AV 225-0859.

PURPOSE: SINBAC develops RISOP or other detailed nuclear war plans.

DESCRIPTION:
Domain: Land, sea, air, and space.

Span: Global.

Environment: Geographic coordinates, broad country outlines.

Force Composition: Missile silos, mobile launcher, SSBN, SSN, and bomber.

Scope of Conflict: Nuclear.

Mission Area: Strategic forces, intermediate nuclear forces.

Level of Detail of Processes and Entities: Individual nuclear weapons; i.e., each missile RV, SLCM, SRAM, ALCM, and bomb, with their sorties (bomber routes and missile footprints). Timing to the second. Targets are individual installations.

CONSTRUCTION:
Human Participation: Required for decisions as plan is built.

Time Processing: Plan is static.

Treatment of Randomness: Plan is deterministic, using expected value.

Sidedness: Two-sided. Plan is asymmetric with one side nonreactive.

LIMITATIONS: Does not model detailed refueling or air defense penetration.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improved user interface, interactive graphics, and relational data base.

INPUT: Detailed weapon orders of battle and characteristics; detailed target bases; and controls over the allocation.

OUTPUT: Hardcopy reports and magnetic tapes summarizing data and results such as damage expectancy, attack timing, residual weapons, and casualties.

HARDWARE AND SOFTWARE:
Computer: VAX 8700 (VMS).
Storage: Extensive disk storage needed, covers multiple drives.
Peripherals: VT-100-type terminals, printer.
Language: VAX FORTRAN, DEC FMS, and DATATRIEVE.
Documentation: Data base, user's, and maintenance manuals.

SECURITY CLASSIFICATION: Model itself is unclassified.

GENERAL DATA:

Data Base: RISOP 6 months.

CPU time per Cycle: RISOP 500 hours.

Data Output Analysis: RISOP 2 months.

Frequency of Use: Annual cycle/continuous use for studies.

Users: J-8.

Comments: Model has been stripped of former SIOP/RISOP wargaming module.

TITLE: SITAP - Simulation for Transportation Analysis and Planning.

DATE IMPLEMENTED: 1968.

MODEL TYPE: Analysis.

PROPONENT: Logistics Directorate, The Joint Staff, The Pentagon, Washington, DC.

POINT OF CONTACT: Nancy Hardy, (703) 694-8026, AV 224-8026.

PURPOSE: SITAP provides the user with an insight into the operational behavior of a given inter/intratheater transportation system through simulation modeling.

DESCRIPTION:

Domain: Land, air, and sea.

Span: Accommodates any theater depending on data base.

Environment: N/A.

Force Composition: Joint and combined forces.

Scope of Conflict: Conventional.

Mission Area: Conventional mission.

Level of Detail of Processes and Entities: Individual aircraft and ships.

CONSTRUCTION:

Human Participation: Not Permitted.

Time Processing: Dynamic, time-step and event-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Scenario needs to be generated by hand; necessary data not always available.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Structure code.

INPUT: MORSA Data Base System produces movement requirements from OPLAN TPFDDs and JPAM data bases.

OUTPUT: Provides detailed reports on simulation activity and produces tabular reports and graphic displays.

HARDWARE AND SOFTWARE:

Computer: Runs on the VAX under VMS and the IBM under TSO.
Storage: 75 MB.
Peripherals: Minimum requirements: one printer and one terminal.
Language: FORTRAN.
Documentation: SITAP manual.

SECURITY CLASSIFICATION: Model is unclassified, but data bases are often classified.

GENERAL DATA:
Data Base: 5 to 10 days.

CPU time per Cycle: Size dependent (from 5 to 40 minutes of CPU time).

Data Output Analysis: Graphic displays and tabular reports produced by postprocessor aid in analysis.

Frequency of Use: N/A.

Users: NATO, SHAPE, Naval War College, Australian Ministry of Defense, and EUCOM.

Comments: N/A.

TITLE: SLAM - Ship Level Analysis Model.

DATE IMPLEMENTED: February 1990.

PROPONENT: Naval Surface Warfare Center (NAVSWC).

POINT OF CONTACT: R. Halbedl (301) 394-1927.

PURPOSE: SLAM is a derivative of the Ship Combat Systems Simulation (SCSS). SLAM's primary use is to measure combat systems self-defense effectiveness based on missile/threat & weapon system characteristics. Current or proposed weapon systems can be integrated (network style) into existing systems to determine improvements in combat system performance.

DESCRIPTION:

Domain: Point defense air/sea.

Span: Individual ship systems.

Environment: Ocean-wind, sea state, wave peak period, temperature.

Force Competition: Single ship and individual weapon system components.

Scope of Conflict: Conventional weapons.

Mission Area: Anti-Air Warfare used in self-defense.

Level of Detail of Processes and Entities: The ship's combat system is treated as an information-flow network so that individual components may be studied in context of information received, information processed (and delayed), and information used. A typical SLAM network can be represented by a link/node diagram. The nodes are elements of a ship combat system, such as a fire control radar, weapon launcher, or scheduling computer. These nodes linked together make up the combat system. Using this network simulation, threats, such as missiles and aircraft, can be deployed against the combat system to measure features, such as response time, strong and weak areas of radar coverage, launched weapon performance, integration efficiency, etc.

CONSTRUCTION:

Human Participation: Not required, but the model is interruptable to check modeled systems/values during a real time run.

Time Processing: Dynamic modeling with events driven by time as well as other events.

Treatment of Randomness: Stochastic modeling with some processes using direct computation and other functions using Monte Carlo.

Sidedness: N/A.

LIMITATIONS: No treatment of Antisurface (ASUW) or Antisubsurface (ASW) warfare areas; no force level analysis capabilities; not C3I integration; no electromagnetic interference modeling.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Scenario development takes as input environment data and characteristics for missiles, launchers, computers, operators, radars, such as range, frequency, speed, envelopes, channels, seeker characteristics, flight profile, reaction times, etc., as applicable to each element modeled.

OUTPUT: SLAM produces output files or event data for missile positions, equipment events (such as firm track, weapon designation, radar blips, fire messages, break engage messages, etc., in text format. Also, output files are produced in SQL data base format for subsequent querying capabilities. Interactively, the user can see SLAM run using a graphical user interface where missiles, ships, data screens are presented as a scenario runs. Graphical pictures are associated with real world elements modeled and computer values can be seen changing as the scenario runs. The user can zoom into areas on the screen where action is taking place as well as see graphically missile flight profiles and seekers displayed.

HARDWARE AND SOFTWARE:

Computer:	SUN workstations using UNIX with Openlook or SUN View. Source code is portable to any system that uses SIMSCRIPT II.5 and SIMGRAPHICS.
Storage:	1 gigabyte external hard drive networked with SUN workstation.
Peripherals:	One SUN workstation with graphics capabilities. A workstation hard disk and at least 16 megabytes of internal RAM is recommended for speed.
Language:	SIMSCRIPT II.5, SIMGRAPHICS.
Documentation:	Documentation is kept for modeled equipment and format. No documentation exists on graphics development.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: A single scenario can take from one to three days to specify depending on existing data and number/pieces of equipment involved.

CPU time per Cycle: Dependent on scenario detail and processes involved. Typical AAW scenarios take from two to ten minutes to run per iteration.

Data Output Analysis: Done via SQL output files for high level of detail. Low level output file is used to focus on particular events with a scenario.

Frequency of Use: Used on two to three major analysis projects per year.

Users: Naval Surface Warfare Center (NAVSWC) and the Weapons Systems Research Laboratory (NSW, Australia). The earlier version, Ship Combat System Simulation (SCSS) exists at Naval Ocean System Center, Naval Weapons Center.

Comments: None.

TITLE: SLIC - Simulated Low Intensity Conflict.

DATE IMPLEMENTED: December 1990.

MODEL TYPE: Training and Education

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: The SLIC model is a training and educational tool used to provide participants with some experience in the insurgency/counterinsurgency environment of a typical host nation. It is designed as a tool for students who want to apply concepts and principles learned in a core low-intensity conflict (LIC) phase of the school's curriculum.

DESCRIPTION:

Domain: Game board/map using counters, markers, and various political and military status tracks. Computer is used to speed and simplify the adjudication process of the exercise.

Span: Local area low-intensity conflict.

Environment: Current implementation is for the country of Nicaragua. It portrays the Somoza-Sandinista conflict.

Force Composition: Government forces versus rebel forces. Military may or may not be used.

Scope of Conflict: Low-intensity conflict.

Mission Area: Teams formulate a campaign plan based on curriculum instruction and the internal defense and development strategy outlined in FM 100-20/AFP 3-20, Military Operations in Low-Intensity Conflict. The campaign plan focuses on LIC from the viewpoint of a campaign for control of an entire country.

Level of Detail of Processes and Entities: Participants make decisions concerning both the political and military aspects of LIC, primarily at the military and operational strategy level. Teams direct the development and employment of resources as diverse as political activists, armored battalions, political fronts, heavy infantry, intelligence assets, and economic aid.

CONSTRUCTION:

Human Participation: Required for decisions.

Time Responses: Static.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: This model is very limited in scope. See Functional Description (FD) for further details.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None as of early 1991.

INPUT: SLIC is not designed to directly interface with the student. Rather, the Faculty Instructor (FI) normally operates the computer and makes all inputs and receives all outputs. The FI creates the wargame by inputting starting values for the game scenario. The FI then has the option to load a new game based on these inputs or reload values saved at some point during game execution. Student players then decide what adjustments to make to political and military status tracks, flags, and values. The FI then enters these values into the proper input screens.

OUTPUT: SLIC communicates all outputs on the display screen. After the FI enters the starting values, SLIC maintains and adjusts the political and military values in accordance with the game rules of adjudication (see Appendix B of the FD). Results are displayed when appropriate. FIs and students can view the current values of political and military status tracks at any time throughout exercise play by requesting this particular display.

HARDWARE AND SOFTWARE:

Computer (OS):	IBM-compatible MS-DOS machine with floppy and hard-disk drive storage, 640 kilobytes random access memory, removable Bernoulli drive, and a CGA color monitor.
Storage:	Requires 130 kilobytes for executable and 500 Kilobytes for disk work space.
Peripherals:	CGA color monitor.
Language:	Turbo Pascal 5.5.
Documentation:	Functional Description, User Specification, User Manual, Maintenance Manual, and Rule Book.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Requires about 60 Kilobytes.

CPU time per Cycle: Not applicable.

Data Output Analysis: Includes a developer test mode to view dice rolls.

Frequency of Use: One to two times per year.

Users: Air Command and Staff College.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: SNAP - Strategic Nuclear Attack Planning.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Strategic Systems Analysis Branch (C314), DSSO, DISA, The Pentagon, Washington, DC 20318-7010.

POINT OF CONTACT: Dr. Dan Wu and Mr. Khoa Nguyen, (703) 695-0025, AV 225-0025.

PURPOSE: SNAP was developed to assist military planners in solving problems involving a strategic nuclear attack plan on potential enemy resources. The number and allocations of the DGZs of the allocated weapons are determined by user-specified parameters. The allocation technique, which uses military judgment and experience for the selection of weapons, targets, and allocation parameters, provides considerable flexibility to the user of the system.

DESCRIPTION:

Domain: Up to 80 nuclear weapons systems from up to 80 launch areas.

Span: Single-sided strategic or theater nuclear level.

Environment: Prompt nuclear blast effect.

Force Composition: RED offensive threat and BLUE target base (or vice versa).

Scope of Conflict: Strategic offensive nuclear exchange analysis.

Mission Area: Strategic conflict.

Level of Detail of Processes and Entities: SNAP is capable of allocating a given mixed weapon arsenal with or without range restrictions to a given target data base of the strategic or theater nuclear level. The model fulfills planning restrictions and requirements such as heights of burst (fallout free, specified, optimal), minimum kill per weapon, number of weapons per DGZ, population avoidance restrictions, and cross targeting of time-phased attacks using circular or polygon range constraints.

CONSTRUCTION:

Human Participation: SNAP can accept military judgment and experience in the selection of objectives, weapons, and targets. The planner may change these inputs to the system as the results of previous selections for an attack plan are assessed.

Time Processing: Static allocation of weapons to targets over time.

Treatment of Randomness: Not directly used (a damage expectancy model).

Sidedness: One-sided.

LIMITATIONS: Model measures prompt blast effects only. Code is not well documented.

PLANNED IMPROVEMENTS AND MODIFICATIONS: SNAP is undergoing enhancement through DSSO. The mode is being enhanced, modified, and recoded. The improved SNAP will be renamed N-SNAP. Estimated delivery of N-SNAP is November 1989.

INPUT: JRAD (336-character) target data base and user-supplied weapon, launcher, and wave-by-wave scenario files.

OUTPUT: Several dozen reports including DGZ/strike file, cumulative weapon report, and target category report. Graphics reports include bar and pie charts and maps.

HARDWARE AND SOFTWARE:

Computer:	VAX (11/780 or compatible) with VMS 4.0.
Storage:	700 blocks to store executable image; 300 blocks data files; 30 million bytes virtual memory (60,000 pages).
Peripherals:	VT 200 Tektronics terminals; line/laser printer for report review.
Language:	40,000 lines FORTRAN, DISSPLA, DCL.
Documentation:	User's guide.

SECURITY CLASSIFICATION: Unclassified without input data; secret with input data.

GENERAL DATA:

Data Base: Currently supported by user-generated flat files. Separate effort underway to support the files with INGRES data base calls.

CPU time per Cycle: 10-30 minutes (depending on size of target base).

Data Output Analysis: N/A.

Frequency of Use: Used daily.

Users: The Joint Staff/J-8 until delivery of N-SNAP in November 1989.

Comments: None.

TITLE: SODSIM - Strategic Offense/Defense Simulation.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Strategic Defense Initiative Organization (SDIO), The Pentagon, Washington, DC 20301-7100.

POINT OF CONTACT: MAJ Frank Maressa, (703) 693-1608.

PURPOSE: SODSIM is a research and evaluation model developed to provide maximum flexibility and growth potential for analyzing the end-to-end interactions of force exchanges involving RED and BLUE offensive and defensive forces. SODSIM uses inputs representing RED and BLUE offensive and defensive weapon system characteristics to include multi-tiered space-based systems, probes, and airborne platforms. Attack timing, battle management, firing doctrine, and communications options among defense elements can be specified.

SODSIM handles RED and BLUE multi-wave attacks to include targeting offenses and defenses on both sides. The simulation creates a trajectory for each individual attacker and does not aggregate threat objects into threat tubes. There can be at least one action subroutine for each defender and attacker combination.

DESCRIPTION:
Domain: Land, air, space, undersea, and any combinations of these domains.

Span: Full spectrum from individual to global offensive and defensive force elements.

Environment: Time of day as determined by sun's position during scenario.

Force Composition: RED and BLUE strategic offensive and defensive forces.

Scope of Conflict: Strategic nuclear exchange.

Mission Area: Strategic nuclear exchange.

Level of Detail of Processes and Entities: Individual attackers and individual defenders.

CONSTRUCTION:
Human Participation: Required for preparation of input data and decisions related to weapon system operational concepts.

Time Processing: Dynamic, discrete, event-driven, time-oriented simulation.

Treatment of Randomness: Stochastic treatment of all events based on input probabilities or direct computation of probabilities.

Sidedness: Two-sided, asymmetric, reactive.

LIMITATIONS: Does not model sea warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The simulator design will accommodate air-breathing attackers and defenders, and work is being planned to integrate RED and BLUE air-breathing offensive and defensive forces into the simulation.

INPUT: RED and BLUE attack scenarios, weapon system operational performance parameters, and battle management/C3 concepts.

OUTPUT: Raw and statistically analyzed data.

HARDWARE AND SOFTWARE:
Computer: Cray 1, Cray XMP, Cray 2, PC-AT, VAX.
Storage: 5 to 500 MB depending on size of scenario.
Peripherals: Video terminal, printer, or both.
Language: FORTRAN 77.
Documentation: SODSIM User's Manual and SODSIM Technical Reference Manual.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:
Data Base: One-half to two days required for initial preparation.

CPU time per Cycle: Less than one hour for very large scenario.

Data Output Analysis: Postprocessor available in utilities library to augment statistics normally available from a run.

Frequency of Use: Daily use.

Users: Riverside Research Institute, Los Alamos National Laboratory, the Joint Staff, and Blime, Incorporated.

Comments: Questions concerning SODSIM should be referred to Blime, Incorporated, 1600 Duke Street, Suite 430, Alexandria, VA 22314; (703) 549-5787.

TITLE: SOJ - Stand-Off Jamming.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Studies and Analysis Directorate, The Air Force Electronic Warfare Center, ESC, San Antonio, TX 78243-5000.

POINT OF CONTACT: Rick Salinas or Ted Trakas, (512) 925-2391, AV 945-2391.

PURPOSE: Evaluate the ECM effectiveness of a stand-off jammer screening a penetrating aircraft against ground-based radars.

DESCRIPTION:

Domain: Land and air.

Span: Individual scenario.

Environment: Optimum environmental conditions.

Force Composition: N/A (a single SOJ against a single threat radar).

Scope of Conflict: Conventional (RED, BLUE, GRAY).

Mission Area: Threat radar suppression.

Level of Detail of Processes and Entities: The model calculates the radar detection range of a penetrator with no ECM from the SOJ. Then it computes the jammer burn-through range (i.e., the range from the threat where jamming is no longer effective). The model is based on the fundamental range and burn-through equations from radar theory and incorporates a smooth, round earth, line-of-sight concept.

CONSTRUCTION:

Human Participation: Required for processing (data input).

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Atmospheric attenuation, ground clutter, multi-path, ground reflection and terrain masking are not included.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Scenario, aircraft, jammer, and threat data bases.

OUTPUT: Produces a computer screen display and a printout of the results.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	Approximately 62,000 blocks (31 megabytes) of memory is required for the executable code and the data bases.
Peripherals:	A Tektronix 4200 series (graphics) terminal and a Tektronix 4692 series color graphics copier.
Language:	FORTRAN 77.
Documentation:	None.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: The parametric data used in all of the data bases is obtained from our unit's electronic combat data library. The library receives its information from national assets as well as from testing facilities.

CPU time per Cycle: 1-2 minutes.

Data Output Analysis: The output analysis is based on a single percent area coverage number. A dual purpose envelope illustrates radar detection and burn-through range is displayed graphically upon request. The model begins each simulation with the first point of penetrator detection at 0 degrees bearing from the radar site. The model then steps the penetrator radially towards the radar in 1 kilometer increments until burn-through is achieved. This procedure is then repeated for the next 359 degrees around the radar site in 1 degree increments. The final number reflects the percent reduction in detection area achieved by jamming. The computer model compares the radar area of coverage before and after jamming.

Frequency of Use: Several times a year depending on tasking requirements.

Users: AFEWC/SATR.

Comments: None.

TITLE: SOMIC - Special Operations Mission Integration Capability.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Simulations and Gaming Division, SOJ7-S, HQ USSOCOM, MacDill AFB, FL 33608-6001.

POINT OF CONTACT: Ms. Jackie Spencer, AV 968-4906, Commercial (813) 830-4906.

PURPOSE: SOMIC is designed to serve as both an operations support and a force capability tool. It is a windows application used for planning Special Operations Forces (SOF) actions and managing and allocating resources at the command level. It specifically assists a Special Operations planner in manually allocating and automatically tracking resources. The tool provides the following capabilities: target evaluation and selection, mission definition, manual allocation of teams and transport, tracking of resources, notification of infeasible missions and automated calculation of probabilities of success of mission and survival of team.

DESCRIPTION:

Domain: The operating area is defined by the user and includes land, sea, and air.

Span: Designed to manage theater level SOF assets down to individual teams applicable to any theater of operations.

Environment: Using a network of nodes and links, the system takes into account type of weather, local hostile population, communication intercept capability of enemy, location of enemy forces and terrain type. Movement rates are adjusted for type of terrain. The maps are WDBII vector shoreline maps for display purposes.

Force Composition: Joint and Combined, Blue and Red.

Scope of Conflict: Conventional warfare from low-intensity to high-intensity conflict using a broad range of conventional weapons including anti-air, anti-armor, etc. Special emphasis on unconventional, special and rear-area operations.

Mission Area: For the purposes of this model, the following mission areas are defined. Direct action missions include interception of enemy forces, destruction of strategic facilities and interdiction of lines of communication including movement routes and checkpoints. Special reconnaissance missions are information gathering missions. Unconventional warfare missions are primarily for training allied forces. Variations of these missions may also be used.

Level of Detail of Processes and Entities: Models SOF teams, targets, transport, lines of communication, and enemy locations. Using mission templates, model allows manual allocation of teams and transport to targets, missions and resupply. Probabilities of mission success and team survival are calculated. Ground attrition is based on the Analytic Hierarchy Process including the use of pairwise comparisons, using Lanchester coefficients. Air attrition is based on Karr process with Lanchester coefficients. Graphical representation of lines of communication network is shown on vector shoreline maps.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-stepped, event-driven.

Treatment of Randomness: Ground attrition deterministically based on biased exponential implementation of Lanchester coefficients.

Sidedness: Two-sided, asymmetrical. On ground, both sides are reactive. Blue air is nonreactive.

LIMITATIONS: Data preparation is extensive and a SOF planning background is required to fully utilize model capabilities.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Fine tuning of movement rates and transport types is being conducted. System needs to be able to distinguish terrain elevations for mission planning purposes. This capability will probably be incorporated from some other existing tool. Postprocessor and event analysis may be enhanced in future versions to provide planner with more than one version of planned assignments that may be compared and analyzed. Automated data base interface may be included to eliminate extensive data entry and reduce input time. Force and target data could then be automatically loaded into the system via manual input.

INPUT: Requires input of force data, weapons data, transport data, intelligence data and geographic information. All data is entered manually through data entry screen except for graphics display which comes from a resident standard data base.

OUTPUT: Displays information in spreadsheet reports indicating transportation assets available and land and sea team assignments. Lines of communication (LOC) network displayed on operational maps.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a SUN Sparcstation 1+ with UNIX operating system.
Storage:	150,000 kilobytes for code and libraries (does not include data storage).
Peripherals:	Minimum requirements: 1 color printer, 1 graphics suite, 1 SUN Sparcstation 1+.
Language:	"C", MOTIF, OpenWindows.
Documentation:	Extensively documented with 5 published manuals, including documentation describing the mathematical methodology used by the model.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:
Data Base: Population of large data bases can take several man-weeks.

CPU time per Cycle: N/A.

Data Output Analysis: Graphic displays of lines of communication (LOC) network and tabular spreadsheet reports of available transportation assets and land and sea team assignments to missions.

Frequency of Use: As required.

Users: USSOCOM, USASOC, AFSOC, NAVSPECWARCOM, and theater Special Operations Commands.

Comments: Managed through a configuration control board made up of representatives of all users. Continually upgraded based on priorities established by the configuration control board.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SOTACA - State of the Art Contingency Analysis.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Joint Warfare Center, Hurlburt Field, FL 32544.

POINT OF CONTACT: Joint Warfare Center, (904) 844-6926, AV 579-6926.

PURPOSE: SOTACA is an operations support tool (decision aid) used in the time-sensitive planning process by planners of the unified and specified commands to quickly analyze and compare alternative courses of action. The planner can assess feasibility, suitability, acceptability and completeness of the varied courses of action using factors such as force attrition, movement rate to an objective area or in accomplishing the mission, and fuel and ammunition expenditures as measures of effectiveness.

DESCRIPTION:

Domain: The operating area is defined by the user.

Span: Can be scaled for global, theater, regional, local, or individual applications.

Environment: Using a network of nodes and links, the user sets mobility and terrain parameters to define the operating environment.

Force Composition: Any mix of forces can be portrayed by the model, including combined forces, joint forces, or separate component forces.

Scope of Conflict: Any category of weapon or weapon types for friendly and enemy forces can be considered, including conventional, chemical-biological-nuclear, special, rear-area, and political.

Mission Area: Any combination of weapons or procedures mission can be modeled.

Level of Detail of Processes and Entities: Entity: The lowest entity modeled may be a single warrior, weapon, or task force. Processes: Confrontation between opposing forces affects the defined entities that are assigned specific attributes and missions.

CONSTRUCTION:

Human Participation: Interactive with human participation required for decisions and processes.

Time Processing: Dynamic, time-step.

Treatment of Randomness: The model is basically deterministic.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Because SOTACA is a first cut, low-resolution model, the level of detail provides extremely rough calculations for the measures of effectiveness, which limits course of action assessment to comparative analysis techniques. In addition, entity (weapon) attributes, such as power or vulnerability, are defined by relative comparisons based on user experience or user-known limitations of the entity, not necessarily by quantifiable characteristics, such as rate of fire, kill probabilities, or other engineering specifications. Confrontations or conflict between opposing forces occurs only at the user defined nodes of the generated network, a limitation that can be overcome by various gaming techniques.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The above noted limitations are subjects of continued research to improve the current model.

INPUT: The user enters a listing of the available forces, organizes those forces into employable task forces, defines their power and vulnerability attributes, establishes logistic factors, defines the operating area, and defines the employment plan of all forces in the operating area.

OUTPUT: Computer printouts or screen displays that contain raw data of force attrition, ammunition and fuel usage, time elapsed, unit locations, and other data used for analysis.

HARDWARE AND SOFTWARE:

Computer:	VAX 11-780, 8600/8700, or MicroVAX with Tektronics VT100 or 4107/4109/4207/4209 terminal.
Storage:	Minimum storage required (WITHOUT DATA) is 120,000 disk blocks (512 bytes/block).
Peripherals:	A printer for hardcopy outputs is required.
Language:	The model is designed in FORTRAN.
Documentation:	A user's manual for the current version is available as well as documentation describing the mathematical methodology used by the model.

SECURITY CLASSIFICATION: Unclassified, but the user data base is classified.

GENERAL DATA:

Data Base: 48 hours or less.

CPU time per Cycle: 8 hours of real time can be replicated by the model in 3 seconds of CPU time.

Data Output Analysis: Several hours.

Frequency of Use: As required.

Users: CINCs of unified and specified commands.

Comments: Times stated for data base input and data output analysis are entirely dependent on level of detail and quantity of data. SOTACA has been designed to compare multiple courses of action to determine differences between different employment schemes. This allows a planning staff to consider various options in determining the most effective employment strategy of assigned forces.

TITLE: SpaceCEM - Space Communications Effectiveness Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Warfare Center (AFEWC)/SAZ, Special Studies Division, Kelly AFB, TX 78243-5000.

POINT OF CONTACT: Lt Col James H. Johnson, DSN 969-2296, Commercial (512) 977-2296.

PURPOSE: SpaceCEM is used to analyze the performance of satellite communication systems by looking at the effects of jamming (ground, air, or space based), rain, terrain, and nuclear scintillation caused by single or multi-burst scenarios. Through data base input, specific ground sites, satellites, and jammer locations can be selected for analysis. Parametric data for each ground terminal and satellite, connectivity, communication rates, and simulation event times further define the analysis setup.

DESCRIPTION:
Domain: Space.

Span: Dependent upon data base input. Focus can vary from global, through regional areas, down to specific locations.

Environment: Terrain relief, weather, and nuclear disturbed environments are taken into account.

Force Composition: Red and Blue forces can be modeled. Dependent upon data base input.

Scope of Conflict: Only high altitude nuclear weapon effects on communication links are incorporated.

Mission Area: Dependent upon data base input.

Level of Detail of Processes and Entities: Lowest entity modeled is a specific satellite or ground terminal system. Processes that will affect entities are movement of ground terminals (air, sea, or mobile land based) satellite orbits, communications link connectivity, as well as link outages caused by terrain obscura, weather margins being exceeded, jamming, equipment outages, and nuclear scintillation.

CONSTRUCTION:
Human Participation: Required for processes and initial setup of each analysis. Model is not interactive.

Time Processing: Dynamic, time and event driven. Nuclear environment must be developed before being incorporated into SpaceCEM analysis.

Treatment of Randomness: Deterministic.

Sidedness: One-sided. Only one operator at a time for each.

LIMITATIONS: Does not model detailed network communications systems or complex satellite transponder/antenna subsystems. Not portable. Requires ORACLE data base and Evans & Sutherland graphics terminal.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Rehosting to 80386 personal computer, Sun workstations, and C programming language in progress.

INPUT: Keyboard or direct reading of data base files.

OUTPUT: Graphic display with printouts of specified communication link parameters at predetermined intervals.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with VMS operating system, ORACLE data base.
Storage:	Evans & Sutherland Graphics terminal.
Language:	Program written in FORTRAN and Evans & Sutherland Graphics Language.

SECURITY CLASSIFICATION: Unclassified, without data bases.

GENERAL DATA:

Data Base: Time to populate data base for a specific analysis depends upon size and availability of accurate satellite, ground station, and data link parameters.

CPU time per Cycle: Dependent upon data base input, but usually requires only several hours of CPU time.

Data Output Analysis: Graphical display of events on globe and flat map projections. Hardcopy of raw data.

Frequency of Use: Several time a year, depending upon tasking.

Users Air Force Electronic Warfare Center (AFEWC).

Comments: Nuclear environment is developed by Defense Nuclear Agency (DNA) approved SCENARIO engineering model. SCENARIO requires several days of VAX computer CPU time and output files are enormous.

TITLE: SPAM - Self-Protection Analysis Model.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: Concepts Analysis Division, System Engineering Lab, Georgia Tech Research Institute, Georgia Institute of Technology, Atlanta, GA 30332.

POINT OF CONTACT: W.E. Sears III, (404) 894-3592.

PURPOSE: SPAM is a research and evaluation tool used to predict the effectiveness of a single threat weapon system against up to two target aircraft employing ECM.

DESCRIPTION:
Domain: Surface-to-air or air-to-air weapon system against target aircraft.

Span: One-on-one or one-on-two.

Environment: Flat earth.

Force Composition: One threat weapon system against one or two target aircraft.

Scope of Conflict: Conventional weapons.

Mission Area: Surface-to-air or air-to-air weapon system against one or two target aircraft.

Level of Detail of Processes and Entities: Engineering level of detail with particular emphasis on modeling of ECM and weapon system RF receiver and ECCM. ECM effectiveness is assessed using tracking errors and miss distance as measures of effectiveness.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic but some subprocesses, such as receiver noise or signal phase, may be modeled as random.

Sidedness: Two-sided, asymmetric, reactive.

LIMITATIONS: 3DOF flyout. Two targets. No clutter/multi-path for airborne radar. Assumes weapon system TTR already in track mode.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Integration with 6DOF flyout.

INPUT: Radar design and parameters, antenna pattern lookup table, aircraft RCS and jammer antenna pattern tables, missile aerodynamic data, and ECM waveforms.

OUTPUT: Printouts and plots.

HARDWARE AND SOFTWARE:
Computer: MicroVAX, VMS.
Storage: 20 MB.
Peripherals: Dot matrix printer, PC with GKS, and laser printer.
Language: FORTRAN.
Documentation: A nonintegrated collection of technical memoranda.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:
Data Base: Several days to prepare.

CPU time per Cycle: 2-15 minutes.

Data Output Analysis: May be used as output.

Frequency of Use: Constant.

Users: Used by Georgia Tech Research Institute on government contracts for TAWC, ASD, WRALC.

TITLE: SPAN - Signal Parametric Analysis of Potential Critical Nodes.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Electronic Proving Ground ATTN: [STEEP-(T-E)], Ft. Huachuca, AZ 85613-7110.

POINT OF CONTACT: Steven Cooper, (602) 538-4953, AV 879-4953.

PURPOSE: SPAN is an operational support tool (decision aid) that contains electronic signature templates of both BLUE and RED command posts and other critical nodes in a tactical deployment. SPAN is primarily used to determine the practicality of using collectable and measurable electromagnetic parameters that are emitted by battlefield transmitters to identify potential, critical, battlefield targets.

DESCRIPTION:

Domain: Land.

Span: RED threat forces.

Environment: RF domain identifying signatures.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: Contains all collectable emitter RF characteristics of both BLUE and RED forces in full warfare in central Europe from 100 KHz to 16 GHz. Contains type of node, type of equipment, frequency, tuning range, type of modulation, pulse repetition rate, pulse duration, antenna scan data, and number of channels, as applicable, for each emitter at each critical node. In addition, information concerning the validity of the data is also provided for the RED emitters. The collectable RF data is grouped into parametric classes to provide the capability to determine which parametric class (i.e., template) can be emitted by particular types of critical nodes.

CONSTRUCTION:

Human Participation: None.

Time Processing: Static.

Treatment of Randomness: None.

Sidedness: N/A.

LIMITATIONS: RED data limited to central Europe.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at present.

INPUT: Input data files consist of the data base files created by the SPAN data base software, the directions finder intercept report file, and collocated node information.

OUTPUT: Identification of unique nodes, partial nodes, the detected collocated nodes, and misidentified nodes.

HARDWARE AND SOFTWARE:

Computer:	CYBER 170 and 172.
Storage:	200,000 octal words of 60 bits.
Peripherals:	1 disk storage, 1 magnetic tape drive, and 1 printer.
Language:	FORTRAN 77.
Documentation:	Limited available.

SECURITY CLASSIFICATION: Unclassified, but full data base Top Secret/SI. Collateral Secret version available, but provides limited results.

GENERAL DATA:

Data Base: Preparation of data base can take several man-years. Updates vary according to content.

CPU time per Cycle: Varies with size.

Data Output Analysis: Produces hardcopy results.

Frequency of Use: Limited. Last run 1985.

Users: USAICS.

Comments: This is essentially a data base used to support the SPAN Simulation Model. It has been used to support field applications for CEWI collections systems such as TCAC-D.

TITLE: SPARCS - Signal Processing Architecture Simulator.

DATE IMPLEMENTED: November 1989.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Edward Wojciechowski, ITT Avionics, (201) 284-2793.

PURPOSE: Behavioral, event-time simulator, for analysis of distributed computer architectures.

DESCRIPTION: SPARCS is an interactive, menu-driven, event-time simulator developed by the ITT Advanced Signal Processing Department to perform detailed system-level analysis of non-homogeneous distributed processing systems composed of numerous functionally specialized processing modules.

INPUT: Inputs consist of hardware functional description, network interconnection description, and processing directed-graph description, all in separate disk files.

OUTPUT: Outputs consist of extensive statistics of all system resources and processing, which are compiled during run time. These statistics range from processing element utilization to queue lengths and queue waits for individual processes. During the simulation, the user may display a continuously updated status monitor. This monitor provides graphical representation of the simulated system using directed graph format. Critical system performance criteria such as executing or queued processes and bus transfers are displayed.

HARDWARE AND SOFTWARE:

Computer:	Apollo workstations, SR9.5.1 or later.
Storage:	1M Byte of disk storage; memory requirements: at least 2M Bytes of main memory is recommended.
Language:	FORTRAN 77.
Documentation:	None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Minimal.

Comments: Status of Model - this tool has been used to simulate multi-processor architectures on systems such as ICNIA and INEWS.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SPASM - Unified Sensor Platform Analytical Scenario Model.

DATE IMPLEMENTED: July 16, 1990.

MODEL TYPE: Training and education.

PROPONENT: Naval Air Development Center.

POINT OF CONTACT: Mr. R. Geyer, Code 301; Stephen Curtis (703) 578-8[illegible] Information Spectrum, Inc., 5107 Leesburg Pike, Falls Church, VA 22041.

PURPOSE: The model is used for skills development for an individual. SPASM is an event-step simulation model for assessing operational performance of airborne ASW platforms. At present, it simulates air-ASW engagements involving a single threat target and up to three ASW aircraft.

DESCRIPTION:
Domain: Sea and air.

Span: Local.

Environment: Surface distances.

Force Composition: Single threat target and up to three ASW aircraft.

Scope of Conflict: Conventional.

Mission Area: Objective detection and destruction of opposition submarine.

Level of Detail of Processes and Entities: Single threat target and up to three ASW aircraft.

CONSTRUCTION:
Human Participation: Required for decisions and continue to run without a decision.

Time Processing: Event-step simulation model.

Treatment of Randomness: Stochastic both direct computation and Monte Carlo.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SPEC - Space Environmental Compatibility Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North, Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: SPEC is a research and evaluation tool that evaluates electromagnetic interactions between large numbers of space and terrestrial systems. SPEC can be used to determine the connectivity and interference, both intentional and unintentional, from space system to space system, space system to terrestrial system, and terrestrial system to space system. The model is used to determine the incident power density or received signal power to uplink, downlink, and/or crosslink receivers. SPEC uses U.S. Space Command's ASTROLIB routines to determine orbital positions allowing a wide variety of orbits to be considered. Color coded graphics illustrating the orbital positions of the space systems provide identification of incidents when user specified thresholds have been exceeded. Menus provide an interface conducive to performing large or small analyses. Printed colored graphics along with hardcopy reports convey results.

DESCRIPTION:

Domain: Earth-to-space, space-to-earth, and space-to-space.

Span: Global, theater, regional, local, or individual.

Environment: Atmospheric drag considered in orbital path calculation.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Communications.

Level of Detail of Processes and Entities: Receiver modes, transmitter modes, 3-D antenna gain patterns.

CONSTRUCTION:

Human Participation: Required to define electromagnetic environment, operational characteristics, and deployment.

Time Processing: Dynamic time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: No terrain effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Rain attenuation and scintillation effects, display of antenna pointing angles.

INPUT: Communication equipment characteristics and locations, time span of interest, satellite orbital parameters.

OUTPUT: Received signal power, incident power density, graphics workstation display of equipment location, and power levels as a function of time.

HARDWARE AND SOFTWARE:

Computer: Sun 4/370, SGI 4D35.

Storage: 16 MB, RAM; 500 MB, Disk.

Peripherals: 3/4 inch type drive, laser printer, QMS Colorscript 100 color printer.

Language: FORTRAN, C, SQL, embedded SQL.

Documentation: Draft User's Manual.

SECURITY CLASSIFICATION: Unclassified program, data may be unclassified, confidential, secret, top secret, or top secret/sensitive compartmented information.

GENERAL DATA:

Data Base: Adding data for large environment could take several weeks.

CPU time per Cycle: N/A.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Varies per analysis.

Users: DoD, ECAC.

Comments: Developed by ECAC.

TITLE: SPECT8/CIMUL8.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: BDM International, Inc.

POINT OF CONTACT: Peter Lattimore (505) 848-5185.

PURPOSE: SPECT8™/CIMUL8™ is an input-driven simulation that can be used to assess the military worth of proposed or existing systems and associated employment concepts in operationally realistic environments. The simulation has been used to support systems requirements definition as well as system effectiveness and survivability. The systems modeled can be space, air, ground, or seabased and may be weapons systems, sensors, communications systems, and/or disrupter (jammer) systems. The SPECT8 portion is a state-of-the-art graphics/analysis tool to facilitate the use of CIMUL8.

DESCRIPTION:

Domain: Space, air, land, sea, and undersea.

Span: Has been applied to problems from global nuclear exchange to air vehicles penetrating a terminal defense.

Environment: Terrain relief, weather (cloud layers, wind, and visibility), and terrain cultural features.

Force Composition: Combined and joint forces, Red, Blue, and Gray, down to the individual person level.

Scope of Conflict: Conventional, nuclear-chemical-biological, special operations, limited conflict, and rear area support.

Mission Area: All mission areas.

Level of Detail of Processes and Entities: Entities: Single units (tank, aircraft, ship, person, crew, etc.) up to any level of aggregation. Processes: Attrition (using multi-dimensional Pk tables), local resupply, movement (terrain following, surface/sea movement, point-to-point, etc.), communications (explicit or implicit radio range equation), sensing (radar, IR, and optical), resource usage (e.g., fuel, ammunition, etc.) and jamming (explicit or implicit range equation).

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic. SPECT8/CIMUL8 is primarily event-stepped with synchronous time-steps for weapon flyout and sensing.

Treatment of Randomness: Stochastic with direct computation of probabilities (cloud placement, scan-to-scan detection, unit availability, and Pk) and Monte Carlo determination of results.

Sidedness: N-sided, symmetric, reactive model.

LIMITATIONS: Is input-driven and therefore requires data base development.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhancement of the user graphical interface.

INPUT: Input data bases are free-form textual files which include environmental data (terrain, clouds, visibility tables, etc.), performance characteristics of systems (antenna patterns, power output, fuel burn rates, etc.), interactions (susceptibilities, tactics, etc.) and interrelationships (command structure, lost comm tactics, etc.) of entities and location and movement data.

OUTPUT: Produces printout of events selected by user. Also a postprocessor capability can select events by entity(s) and/or event(s) for textual or graphical output. Graphical editor can display graphically and modify entity preplanned positions and movement paths.

HARDWARE AND SOFTWARE:

Computer:	Currently runs on Amiga, MacIntosh II, MacIntosh SE/30, 80386/80486-based Personal Computer, VAX computers, SUN workstations, RS 6000 and other UNIX-based computers. 4 M of memory is minimum for reasonable scenarios. GKS and Intuition graphics packages are supported.
Storage:	Dependent on scenario size.
Peripherals:	Graphics terminal for graphics output.
Language:	C.
Documentation:	Extensively documented with five published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Dependent on scenario size and complexity. Typical data bases are 10,000 - 15,000 lines long.

CPU time per Cycle: Dependent on data base size and number of players. Large scenarios can run between real time and twice real time.

Data Output Analysis: Postprocessor can produce textual and graphical summaries of data.

Frequency of Use: Several times per year.

Users: BDMI and other government and industry users (available upon request).

Comments: SPECT8/CIMUL8 is propriety software available for licensing as a package.

TITLE: SPEED84 - Simulation of Penetrators Encountering Extensive Defense.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: WRDC, Avionics Laboratory, Analysis and Evaluation Branch (WRDC/AAWA), Wright-Patterson AFB, OH 45433-6543.

POINT OF CONTACT: Mr. Bill McQuay, (513) 255-2164.

PURPOSE: SPEED84 is designed to provide a methodology by which the analyst can understand the interactions among the penetrating forces and the various facets of an integrated air defense system, and quantitatively assess the overall impact on bomber force effectiveness of penetration system variations including the number of air vehicles, ECM used, and decoy deployment.

DESCRIPTION:

Domain: Land and air.

Span: Regional.

Environment: A few impacts of weather, such as the effects of clouds, can be modeled. Ground sites are degraded in their tracking abilities as are threat kill capabilities.

Force Composition: Joint and combined forces.

Scope of Conflict: Conventional and nuclear.

Mission Area: Integrated air defense.

Level of Detail of Processes and Entities: Airspace is defended by an extensive network of early warning and GCI radars, command and control systems, airborne interceptors and surface-to-air weapon systems. The airborne forces may include manned bombers, cruise missiles, air-to-surface missiles, gravity bombs, decoys, and support aircraft such as remotely piloted vehicles.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric; only the defender reacts to events within the engagement.

LIMITATIONS: Many specific aspects of the battle modeled are subject to considerable aggregation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Penetrator vehicle types, radar type, RF/EO detection tables, threat description, ground threat probability tables, interceptor description, interceptor probability tables, long range missile fuel tables, weapon data, radar sites, ground threat sites, GCI sites, airbases, subcontrol centers, A/C characteristics, DCZs, manned vehicles, long range missiles, degradation tables, environmental effects, and ground-based jammers and sensors.

OUTPUT: Input echo, situation descriptions, listings, and plots.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage: 491,008 bytes.
Peripherals: No special requirements.
Language: FORTRAN IV.
Documentation: User's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: 36.2 CPs.

Data Output Analysis: 4.2 CPs.

Frequency of Use: Varies depending on requirements.

Users: Primarily WRDC/AAWA.

Comments: N/A.

TITLE: SPEED 88 - Simulation of Penetrators Encountering Extensive Defenses.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The SPEED 88 model is a mathematical representation of an airborne force penetrating the airspace over an extended geographical region.

DESCRIPTION: SPEED 88 economically generates histories of events in a simulated large scale air conflict, and summarizes engagements and outcomes, thereby allowing examination of the results of engagements between individual offensive and defensive weapons.

Airspace is defended by an extensive network of Early Warning (EW) and Ground Controlled Intercept (GCI) radars, Command and Control (C and C) systems, Airborne Interceptors (AI), and surface-to-air weapon systems. The airborne forces may include manned bombers, cruise missiles, air-to-surface missiles, gravity bombs, decoys, and support aircraft such as Remotely Piloted Vehicles (RPVs). SPEED 88 provides a time sequenced, event-based, Monte Carlo simulation of the interactions which may occur between the individual elements of the penetrating forces and the elements of the defensive in a total mission environment. "Monte Carlo" means that the model is stochastic; that is, many factors influencing the course of events are represented by random variables sampled in accord with computed probability descriptions. "Event-based" means that the simulation sequences from each "key event" to the next, allowing variable time intervals between simulation steps.

The SPEED 88 model can simulate penetrations through very large areas; the practical geographic area limits are 2500 X 6000 nautical miles (n.mi.). Mission times of up to 18 hours duration are possible. In this respect, the first penetrator entering the defined air space and the destruction or departure of the last existing penetrator define the limits of the simulated air battle. Very large numbers can be accommodated within the available storage capacity of the VAX 11/780 being used in AAWA-1.

SPEED 88 is a fast running model: much faster than real time, even with large numbers of offense and defense elements. This speed is achieved by using as input precomputed radar and weapon effectiveness data to calculate detection tables and kills of penetrators and defense sites. Probability of detection tables relate performance of each radar type to the type, range, and available Electronic Countermeasures (ECM) of the penetrators based on the relative geometry of each encounter. Similarly, kill probability tables relate penetrator type, missile/warhead type, engagement geometry, miss distances, and closing velocity to weapon system probability of kill (Pk).

The objective in developing the SPEED model for the Air Force was to provide a methodology by which the analyst could:

- Obtain an understanding of the interactions among the penetrating forces and the various facets of an integrated air defense system, and

- Quantitatively assess the overall impact on bomber force effectiveness of penetration system variations, including numbers of air vehicles, ECM used, and decoy deployment.

In addition to the above applications, other applications of SPEED to systems analysis include:

- Providing insight into the sensitivity of mission effectiveness to one-on-one effectiveness data.

- Examining the compatibility of mixes of weapons systems.

- Providing insight into tradeoffs between competing and complementing systems.

<u>LIMITATIONS</u>: SPEED1 SPEED2 POST

<u>INPUT</u>: The bulk of the instruction for the SPEED1 main program is devoted to reading and formatting of input data for use in SPEED2. The input data is supplied in card image form, and is grouped into 21 different data sets, plus some initial run control data. The inputs can be provided by any combination of cards, disk files, and tape.

- Penetrator vehicle types
- Radar type
- RF/EO detection tables
- Threat description tables
- Ground threat probability tables
- Interceptor description
- Long range missiles
- Interceptor probability tables
- Long range missile fuel tables
- Ground-based jammers and sensors
- Radar sites
- GCI sites
- Airbases
- Subcontrol centers
- ZOC characteristics
- DSZs
- Manned vehicles
- Ground threat sites
- Degradation tables
- Environmental effects
- Weapon data

<u>OUTPUT</u>: SPEED1 can print a number of variables that may be useful in debugging. The output consists of SPEED2 log input, concatenated with a printed repetition of the contents of the 21 data sets. Immediately following is a list of the actual mask angles determined for each SAM and radar site and a list of the primary events. Finally, a scoreboard of the event types generated is listed.

The primary output of SPEED2 are event lists that are used by SPEED3 and POST to accumulate and display overall mission results. There are, however, some outputs of SPEED that are directly useful to the analyst.

SPEED2 summarizes the offensive and defensive state vectors during the simulation. It can be printed at the option of the user. The penetrator section covers such items as general status, identity of any engaging AI and controlling GCI, target status at [illegible] time of last contact on tracked penetrators and numbers of penet[illegible] weapons of different classes that remain to be launched. The HQ's and AWACS sections provide data on the numbers of target tracks (or detections) of different categories. The INTERCEPTORS section deals with AI currently in flight and includes each last recorded position/time, interceptor type, and whether the AI is on close approach (CAP), loitering, or engaging. The AIRBASES and SAM SITES sections describe operational status and remaining ground AI or missile inventory - the former by AI type.

SPEED2 plots engagements for each defensive weapon type, salvos for each defensive weapon type, and all "unnatural" terminations for each of the penetrator classes within a single replication. For each such termination, the time, cause, coordinates and accumulated range flown are given.

SPEED 88 generates 8 different output tables and 3 types of plots. Examples of the types of plots that can be provided by SPEED 88 as implemented on the WL VAX 11/780 are shown in the sample outputs. SPEED 88 plots the number of surviving aircraft as a function of mission time, displays the cumulative number of kill of AIs as a function of mission time, and displays the cumulative number of SAM engagements and kills respectively as a function of mission time. Bar graphs show the number of SAM engagements, salvos, and kills respectively as a function of SAM type and the cumulative number of weapons (bombs) delivered to the target as a function of mission time.

POST selects records of specific event types generated by SPEED2. The format and content of POST's output is identical to these records.

<u>HARDWARE AND SOFTWARE</u>:
  <u>Computer</u>: VAX 11/780
  <u>Language</u>: FORTRAN IV.
  <u>Documentation</u>: User's Manual.

<u>SECURITY CLASSIFICATION</u>: Source Code is Unclassified.

<u>GENERAL DATA</u>:
  <u>Time Requirements</u>: Compilation time: SPEED1: 92 seconds; SPEED2: 284 seconds; POST: 3.1 seconds. Typical run time: SPEED1: 14.5 seconds; SPEED2: 21.7 seconds; POST: 0.3 seconds.

  <u>Users</u>:

BDM Corporation
GTE Government Systems Corporation
LTV Aircraft Products Group
Loral Advanced Projects
SAIC
Sanders Associates, Inc.
Service Engineering Corporation
The Rand Corporation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SPIRITS - Spectral Infrared Imaging of Targets and Scenes.

DATE IMPLEMENTED: 15 September 1987.

MODEL TYPE: Analysis.

PROPONENT: ECDES Program, ASD/RW, WPAFB.

POINT OF CONTACT: Lt. Col. Glenn Harris, ASD/RWAS, (513) 255-2108.

PURPOSE: SPIRITS is used for simulating infrared signatures of targets in air-to-air, ground-to-air, or ground-to-ground scenarios. The in-band spectral and spatial radiances are used in tactical and strategic sensor performance evaluation, target design and signature prediction, vulnerability analysis, and understanding measured data.

DESCRIPTION:
Domain: Land, sea, air, space, or a combination of land, sea, air, and space.

Span: Accommodates any theater depending on the target data base.

Environment: Atmospheric transmission is calculated by LOWTRAN6.

Force Composition: Combined or component radiation.

Scope of Conflict: Conventional and nuclear warfare.

Mission Area: Searching, tracking, identification, and lock-on.

Level of Detail of Processes and Entities: Any target or group of targets can be modeled (air, ground, sea, space). Phenomena include exhaust plume flowfield and radiation for both axisymmetric and nonaxisymmetric nozzles, target emission and hot parts, reflected sunshine, earthshine, and skyshine, target temperatures (nonuniform convection, radiative transfer, nonequilibrium conduction, internal heat sources), atmospheric transmission and radiance, and 3-D obscuration and display.

CONSTRUCTION:
Human Participation: Required for input descriptions and output analysis.

Time Processing: Static.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: Specific data base input format; no cluttered background.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Secondary reflections, expert system, structured background environment, LOWTRAN7, SIRRM2, general bidirectional reflectance distribution function, first principles heat transfer analysis, improved plume model, generalized object geometry, and polarized backgrounds.

INPUT: Plume flowfield and radiation descriptions, flight parameters (altitude mach number, ambient pressure and temperature, pitch and roll angles, hot part temperatures and paint properties), sensor description (observer's aspect angle, range, aimpoint and field-of-view), and environment description (sun angle, type of earth below, earth altitude and temperature, sky or cloud description, and LOWTRAN6 atmospheric description).

OUTPUT: Spectral and spatial data of the target source (up to 10 band passes). Apparent and contrast radiant intensities, background and foreground irradiances, and source component radiant intensities. Raster image display of apparent in-band radiances for each pixel.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	8-9 megabytes of RAM.
Peripherals:	Raster display device, alphanumeric terminal, and printer.
Language:	ANSI standard FORTRAN 77.
Documentation:	User manual, technical manual, and installation manual.

SECURITY CLASSIFICATION: Critical Military Technology, Non-Exportable, Access prohibited to foreign nationals, inputs closely coupled with outputs can be considered classified.

GENERAL DATA:

Data Base: Many data bases exist from the commercial developer. A new data base requires one to three man-months to develop depending on the original format of the data.

CPU time per Cycle: Average run time (with a plume) is 25 minutes.

Data Output Analysis: Alphanumeric data may be sent to user-defined general purpose 2-D plotting routine.

Frequency of Use: Frequently used by those listed below.

Users: Aerodyne Research, AFEWC/ESA, AFGL/OPF, AFWAL/AAWA, ECAC, General Dynamics, General Electric, Georgia Tech, Grumman Aerospace, Lockheed, Loral E-O Systems, Martin Marietta, McDonnell Douglas, NADC, Northrop, PMTC, Rockwell International, Senders, Tricor Systems, MICOM, and Westinghouse Electric.

Comments: Managed through ECDES to ensure a standard version of the model. Industry coordinator for distribution, training, and user support is Aerodyne Research, Inc.

TITLE: SQuASH - Stochastic Quantitative Analysis of System Hierarchies.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis. (Weapon Systems Vulnerability/Lethality).

PROPONENT: Ballistic Research Laboratory, Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: A. Ozolins, AV 298-7619, Comm (301) 278-7619.

PURPOSE: SQuASH is a stochastic high-detail point-burst type vulnerability/lethality (V/L) code that evaluates both physical and tactical damage to target vehicles attacked by various types of threat munitions. Physical damage is assessed as function kills of operationally critical target components. The combined kill state of all critical components constitutes a "Damage State" which is converted to tactical degradation using a mapping device traditionally known as a DAL (Damage Assessment List). Stochastic processing is applied to physical effects which are known to be intrinsically random. Outputs are, therefore, distributions which represent the various damage configurations that should be possible.

DESCRIPTION:
Domain: Abstract (Tactical damage assessments are globally averaged over all possible combat roles and attack conditions, such as night, day, desert, vegetation, etc.).

Span: Individual threat munitions against individual target vehicles.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:
Human Participation: N/A.

Time Processing: N/A.

Treatment of Randomness: Monte Carlo type stochastic processing is applied to threat propagation, spall fragment characterization, and component-level damage response functions. Optionally, one can collapse sampling functions about their means to do deterministic calculations.

Sidedness: N/A.

LIMITATIONS: Single threat munitions against single target vehicles. Primary threats: KE rounds, shaped-charge warheads, EFPs, and some mines. Primary targets: Combat ground vehicles. Current methodology does not directly account for shock, internal blast, and some secondary damage mechanisms like ricochet or secondary spall.

PLANNED IMPROVEMENTS AND MODIFICATIONS: 1) Replace DAL metrics that map physical damage into tactical degradation with "Degraded States" metrics which are now under development and which are less subjective and mathematically more rigorous. 2) Expand primary threat capabilities to better handle indirect fire munitions--in particular, bursting artillery shells. 3) Based on future need and evidence from Live-Fire Test programs, extend explicit modeling of significant damage mechanisms--notably those that would allow expanding target base to a larger class of vehicles.

INPUT: Munition characteristics, armor characteristics, detailed target geometry, critical component vulnerability characteristics, behind-armor debris characteristics, random variable sampling parameters, tactical damage mapping metrics, and network functions that describe operational interdependence of mission critical components and systems.

OUTPUT: Statistical tables describe target penetration, component, and system level damage (operationally dead or alive) and tactical degradation, such as loss of firepower, loss of mobility, or catastrophic kill. Specific damage is presented on a component-by-component basis and broken down by damage mechanism. It is also presented in combined form as "damage vectors" that probabilistically enumerate a target's most likely damage configurations.

HARDWARE AND SOFTWARE:

Computer:	Super-mini with UNIX (TM) operating system. Has been tested on Alliant FX/8 with Concentrix 3.0, Gould 9080 with UTX/32, and Silicon Graphics 4D Series Workstations with IRIX (3.3).
Storage:	Program - 10 megabytes. Inputs - 10 to 100 Mbytes.
Peripherals:	1 printer, 1 desk-top terminal.
Language:	FORTRAN 5.
Documentation:	None (at present). However, source code is modular and contains extensive internal documentation.

SECURITY CLASSIFICATION: Unclassified, but data inputs may be classified.

GENERAL DATA:

Data Base: Input data preparation times are about 1-2 man-years.

CPU time per Cycle: Varies with type of run (single shot or full-view) and the desired number of Monte Carlo simulations. On Silicon-Graphics 4D workstations single shot analyses for Live-Fire support typically run 1-2 hours (1 CPU). Full-view runs with 10 simulations for each 4 inch grid cell typically run 4-8 hours.

Data Output Analysis: Different tasks require different outputs that support different postprocessing programs. Current options support, SPARC (spare parts) analyses. Degraded-States analyses, and development of damage correlations tables for future use by compartment level vulnerability models.

Frequency of Use: Several times per year.

Users: Ballistic Research Laboratory.

Comments: Although SQuASH is capable of generating both stochastic and conventional outputs for feeding downstream users of vehicle V/L data, it is currently not an efficient production tool. Its main utility is in providing modeling support for Live-Fire test programs for special high-resolution studies that are outside the scope of other V/L codes, for generating synthetic data inputs to lower level models, and as a methodology research tool.

TITLE: SRBS - Skeletal Reference Baseline System.

DATE IMPLEMENTED: January 1987.

MODEL TYPE: Analysis.

PROPONENT: National Test Bed, Falcon AFB, CO 80912-5000.

POINT OF CONTACT: Dudley L. Bromley, (719) 380-2337.

PURPOSE: SRBS is a low-to-medium fidelity model of the SDS that includes a flexible and sophisticated human-machine interface capability. SRBS is ideally suited to assist in the understanding and evaluation of human participation in a strategic defense environment. SRBS is currently being used by the U.S. Space Command to support strategic gaming.

DESCRIPTION:
Domain: Earth and space.

Span: Accommodates any theater depending on data base. Currently targeted areas include NATO, CONUS, and space-based SDS assets.

Environment: User-defined simulated GMT start time and ratio of simulation time to wall clock time. Two-dimensional Mercator projections and three-dimensional globe displays available.

Force Composition: Joint and SDS assets.

Scope of Conflict: Nonnuclear SDS assets including ERIS and SBICVs; RED arsenal components including ICBM, IRBM, SLBM, and ASAT.

Mission Area: All Phase I SDS missions.

Level of Detail of Processes and Entities: Model components include Battle Manager, Command and Control, Communications, Engagement, Environment (earth, moon, sun, but no nuclear effects), Sensors, Threat, Weapons, and MMI. Battle Manager can be either regional or autonomous and includes both space- and ground-based elements. Weapons include ERIS, SBICV, HEDI, and SBL. Sensors include SSTS, BSTS, and GSTS. MMI includes RED, WHITE, and BLUE teams, with the BLUE team containing most C2 capabilities. Intelligence message-passing also available.

CONSTRUCTION:
Human Participation: Required for decisions and processes but can be locked down for repeatability.

Time Processing: Dynamic, either time- or event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided (RED offense, BLUE defense); WHITE umpire function is also provided.

LIMITATIONS: Approximately 1500 threat objects capable of being run in real time (per wave).

PLANNED IMPROVEMENTS AND MODIFICATIONS: Increase number of command element personnel and command centers, integrate Rapid Screen Prototyping Tool, increase threat scenario size, include Battle Manager Predictor, and integrate full analysis capability.

INPUT: Configuration file that defines SDS architecture and associated parameters, initialization file that defines scheduling and distribution software module plus connectivity (i.e., messages) between modules, and scenario files that define threats.

OUTPUT: MMI displays, log file of operator entries (for playback) and log file of recorded messages.

HARDWARE AND SOFTWARE:

Computer(OS):	CRAY 2 Supercomputer, UNICOS Version 4 operating system; ELXSI 6400, EMBOS operating system.
Storage:	155 MB.
Peripherals:	Silicon Graphics workstations (3000 series and 4D series).
Language:	"C," FORTRAN, Pascal.
Documentation:	CDRLs C001-005, IAG Design Criteria Document.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Time to prepare new threat data base varies from one to seven days depending on specifics of threat.

CPU time per Cycle: User can control ratio of real time to simulation time.

Data Output Analysis: Currently limited but will soon include full analysis capability.

Frequency of Use: Used daily.

Users: U.S. Space Command, National Test Bed Integration Contractor.

Comments: N/A.

TITLE: SSBSFN.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

PURPOSE: This program is a spread spectrum signal simulator. It allows frequency and time domain analysis of spread spectrum signals of all types.

DESCRIPTION: It generates chirp, phase coded, pseudo random phase coded, quantized FM and other signals. It can also generate repetitive and chopped signals. The signals are generated and convolved with their corresponding matched filters. Noise and weighting filters may be added.

INPUT: One data file containing type of signal, signal parameters (including phase codes), filter parameters, FFT parameters and plot parameters.

OUTPUT: Plots in time domain and/or frequency domain of the input signal, the filter(s), and the signal output from the filters.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX family.
Storage:	100K Bytes; memory requirements: minimal.
Language:	FORTRAN 77 (VAX).
Documentation:	Program comments, example data file with comments.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Typical data preparation is 5 minutes.

CPU time per Cycle: 15 seconds on VAX computer.

Usage: Advanced ED Systems.

Comments: Plot files are formatted for an in-house plot program, but may be used in other programs.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: STAIR - Simulation of Tactical Airborne Interceptor Radar.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Science Application International Corporation (SAIC).

POINT OF CONTACT: Mark D. Bond, SAIC, (404) 426-9359.

PURPOSE: The purpose of STAIR is to aid the radar systems analyst in the study of airborne radar detection phenomenology.

DESCRIPTION:

Domain: Air.

Span: One aircraft on one radar.

Environment: Round, smooth earth; atmospheric absorption.

Force Composition: Single element BLUE vs. RED or RED vs. BLUE.

Scope of Conflict: Accommodates airborne acquisition and fire control radar, although tracking radar is limited to detection only.

Mission Area: Single penetrator with jammer against a single radar.

Level of Detail of Processes and Entities: Lowest entity modeled is a radar subsystem: transmitter, pulse doppler or MTI circuit, noncoherent integrator, gain control. Pulse doppler and MTI processing implemented as actual system software.

CONSTRUCTION:

Human Participation: Not required or permitted.

Time Processing: Dynamic, real-time emulation.

Treatment of Randomness: Deterministic; random noise implemented in both phase and amplitude.

Sidedness: Symmetric.

LIMITATIONS: Does not model angle, range, or doppler tracking.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Moving target detector (MTD: MTI followed by pulse doppler), extended target and range tracking, and monopulse angle and doppler tracking will be added.

INPUT: N/A.

OUTPUT: N/A.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on VAX computer with VMS operating system.
Storage:	ALARMPP executable = 21,000 bytes. Input files = 75,000 bytes each (including antenna patterns).
Peripherals:	No peripheral support required for operation. A graphics display terminal to view templates is recommended.
Language:	FORTRAN.
Documentation:	A user's manual and input guide are available.

SECURITY CLASSIFICATION: Unclassified, but data bases are often classified.

GENERAL DATA:

Data Base: Data base construction time is minimal provided that preparation is performed by a qualified radar analyst.

CPU time per Cycle: Depends on purpose; may range from several CPU minutes to several CPU hours.

Data Output Analysis: Extensive knowledge of radar processing is required.

Frequency of Use: Extensive use by airframers in the analysis of low observables (LO) design.

Users: N/A.

Comments: Configuration is controlled by SAIC.

TITLE: STAM - SIOP Tanker Analysis Model.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis, Box 7730, M/S k80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: John A. December, Boeing Military Airplanes, Operations Analysis, (316) 526-2956.

PURPOSE: The purpose of the STAM is to determine the tanker requirements for the refueling support of a set of bomber sorties in a SIOP mission.

DESCRIPTION:
Domain: Land and air.

Span: Global.

Environment: Distances.

Force Composition: Strategic bombers.

Scope of Conflict: Nuclear.

Mission Area: SIOP.

Level of Detail of Processes and Entities: Entities: Individual aircraft. Processes: Single air refueling.

CONSTRUCTION:
Human Participation: Required to set up data files for execution.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model aircraft loading, loading times, aborted air refuelings, and replacement aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Input files are required to provide the following information: SIOP force specification (bomber types, fuel burn data, aircraft parameters); and allocation option (type of tanker and costs).

OUTPUT: Output includes summary information on the number of aircraft and types used, fuel burn, and onload amounts; and detailed information on the times, distances, and amounts of each air refueling.

HARDWARE AND SOFTWARE:

Computer: Developed to run in a network of APOLLO DN3000 and DN660 terminals running on an AEGIS-DOMAIN/IX (Unix-based) operating system.

Storage: About 300K for the executable model. Data bases require additional space.

Peripherals: 1 printer and 1 terminal.

Language: APOLLO/DOMAIN Pascal and FORTRAN APOLLO DOMAIN/IX.

Documentation: Documentation for management, user/analysts, and programmers is available.

SECURITY CLASSIFICATION: Unclassified, but data could be classified.

GENERAL DATA:

Data Base: Aircraft data base is established for many aircraft.

CPU time per Cycle: A typical run for finding the best tanker allocation based on user specification is 3 hours.

Data Output Analysis: Output reports include summary output and detailed output in chart form.

Frequency of Use: Used several times per year for tanker analyses.

Users: Boeing Military Airplanes, Operations Analysis, Tanker/Airlift Program Support.

Comments: N/A.

TITLE: STAMP - Strategic and Tactical Attack Modeling Process.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Air Force Foreign Technology Division, Wright-Patterson AFB, OH 45433-6508.

POINT OF CONTACT: Bill Adams, 205-971-6658.

PURPOSE: STAMP is used for modeling the detailed performance and flight history for a large array of strategic and tactical weapon systems, including boost phase maneuvers and PBV Penaid analysis. STAMP is also used for generating large scale strategic and tactical attacks producing a set of threat files for use in detailed analysis.

DESCRIPTION:
Domain: Ballistic and tactical missiles.

Span: Accommodates any one-sided scenario depending on user defined inputs (Theater, Conus, Global).

Environment: Targets must be defined as DGZs and launch points can be either fixed, mobile, or sea based.

Force Composition: Ballistic and Tactical missile components.

Scope of Conflict: Primarily nuclear warfare but conventional, unconventional, and chemical possible for either blue or red.

Mission Area: Strategic attack laydowns involving strategic and tactical ballistic missiles.

Level of Detail of Processes and Entities: Single missile attacks against stationary targets. Reduction in value for targets due to deployment of forces accounted for in scenario generation.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time- and event-stepped model.

Treatment of Randomness: For events which demonstrate randomness interests, such as some PBV timings, the model chooses values based on a defined distribution based on random draw.

Sidedness: One-sided.

LIMITATIONS: Limitations (number of launch points, targets, etc.) are controlled by user. Maximum values are easily changed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Graphical User Interface utilizing a SUN workstation with X-Windows OpenWindows will be used for creating inputs, driving model execution and analysis of outputs in real time. Missile modeling is continually upgraded to be consistent with latest intelligence.

INPUT: STAMP requires launch locations, weapons, target data base, scenario specifications (targeting requirements, RV timing, fratricide, etc.).

OUTPUT: Produces printouts of attack laydown, statistics for weapons involved, and summary of scenario requirements compared to actual attack data. Graphical output aides in performing detailed analysis by producing maps showing attack from launch to target, individual booster trajectory ground traces, detailed PBV deployments and maneuvers, Penaid deployments and more. Standard threat files (Boost, PBV, Object) are created.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system or for Graphical User Interface a SUN with SuOS 4.x.x.
Storage:	100,000 Blocks.
Peripherals:	Minimum requirements: 1 printer, 1 SUN workstation with OpenWindows, CA DISSPLA.
Language:	FORTRAN, Ada, "C", UNIX.
Documentation:	Extensive on-line help available through the OpenWindows and a full set of documents being written.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Generation of scenario data bases can take a couple of weeks.

CPU time per Cycle: Dependent on size of scenario and complexity of weapon system (maneuvers for boost phase, Penaid suites, etc.). Generally for each missile modeled in a scenario 5-20 minutes of CPU time is required.

Data Output Analysis: Postprocessor and graphics provides necessary data for detailed analysis of entire scenario or a single missile.

Users: Space Command, Air Force Foreign Technology Division, SDIO, U.S. Army Strategic Defense Command, Air Force Operational Test and Evaluation Command.

Comments: Managed through a configuration management process. Continually upgraded to model current requirements as specified by intelligence.

TITLE: STAT - Strategic Transportation Analysis Tool.

DATE IMPLEMENTED: July 1985.

MODEL TYPE: Analysis.

PROPONENT: Sandia National Labs (SNL), Albuquerque, NM 87185.

The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Steven C. Haes, (703) 848-6804 or
Edmund J. Bitinas, (703) 848-5246.

PURPOSE: STAT is a research and evaluation tool used to access transportation, logistics, and production network capabilities and limitations over a multi-model transportation network.

DESCRIPTION:

Domain: A transportation network representing sea, air, or ground transportation links and nodes.

Span: Data-driven, from global to local.

Environment: Data-driven; includes time of day and trafficability.

Force Composition: Individual vehicles in convoy packages. Airlift, sealift, heliborne can also be included.

Scope of Conflict: Rear-area. Weapons represented by the effect of using them, including persistent effects.

Mission Area: Sustainability, mobilization, and interdiction.

Level of Detail of Processes and Entities: Trains, items of productions and supply specific or by tonnage (up to 9999 types), specific production facilities, and specific targets. Attrition/damage is input by weapon type. Delay is input as time to repair/reconstitute once assets to perform the repair are made available.

CONSTRUCTION:

Human Participation: Not required. Model interruptable with scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic. Random values are generated from input distributions.

Sidedness: One-sided.

LIMITATIONS: Demands for materials, attacks, and loss of territory must be pre-scripted.

PLANNED IMPROVEMENTS AND MODIFICATIONS: To increase user friendliness of preprocessors and postprocessors.

INPUT: Transportation network (road and rail are available for all of Europe, Korea, and Iran, while only railroad data bases are available for the Soviet Union), scenario, asset stockpiles, asset consumption rates, production rates and inventory levels.

OUTPUT: Postprocessor provides statistically analyzed data overlaid on videodisk map backgrounds or screen and/or hardcopy graphics plots available. Data includes resource and network utilization, supply availability, force arrival rates, and other dynamic measures.

HARDWARE AND SOFTWARE:

Computer:	IBM PS/2 model 80.
Storage:	10 MB.
Peripherals:	Fulcrum videodisk mapping display systems and printer.
Language:	FORTRAN.
Documentation:	User's manual and internal code documentation.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: One to three man-months.

CPU time per Cycle: Scenario- and scale-dependent; typically one to eight hours for entire run.

Data Output Analysis: Postprocessor provides graphics and raw data output.

Frequency of Use: Undetermined.

Users: Sandia National Labs, Joint Strategic Target Planning Staff (JSTPS), and The BDM Corporation.

Comments: None.

TITLE: STB - Surveillance Test Bed.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: Strategic Defense Initiative Organization (SDIO/SDA), The Pentagon, Washington, DC 20318.

POINT OF CONTACT: Col D. Nagy (COTR), AV 223-1608, Commercial (703) 693-1608.

PURPOSE: STB is a non-real time research and evaluation tool being developed to analyze space-based and ground-based sensor surveillance algorithms. STB is a framework with baseline algorithms which can be replaced with operational surveillance algorithms (test articles). The model can be used as a surveillance element driver for system level simulations and gaming simulations.

DESCRIPTION:

Domain: Space - Boost, Post-Boost, Midcourse, and Terminal battlespaces.

Span: Global, theater, regional, local, or individual surveillance platforms/systems can be examined from a detailed performance point of view (tracking timelines, etc.). The STB can also allow examination of components of an individual surveillance platform (sensor, signal processor, and surveillance algorithms).

Environment: A set of environments and environment codes have been selected to represent natural, man-made, and nuclear environments. These include earthlimb, lower & upper atmospheric attenuation and refraction, stars, zodiacal light, terrain, clouds, aurora, chaff, electronic countermeasures, fuel vents, plumes, debris, nuclear mean radiance, RF signal attenuation, prompt and debris radiations, and spatial clutter power spectral densities.

Force Composition: Accommodates any defense surveillance architecture consisting of passive infrared, visible and radar type sensors. The sensor platforms may be orbital, probe-based, or ground-based.

Scope of Conflict: Concerned with conventional and nuclear missile detection, tracking, discrimination, sensor tasking and kill assessment. STB can also allow analysis of surveillance support to weapon intercepts (i.e., hand over data to weapon sensors).

Mission Area: Theater and Strategic Ballistic Missile Defense.

Level of Detail of Processes and Entities: STB is a high fidelity non-real time surveillance test bed. It creates emulated or simulated sensor/signal processing output from complex and stressing threat/environment scenarios. These outputs are used to drive real correlation, tracking, discrimination, and sensor tasking algorithms.

CONSTRUCTION:

Human Participation: The STB is designed to allow user definition of environments, architecture, and threat with preview support. During a run, human participation is not required. Monitoring of the run's progression is allowed, however, and the STB is interruptable.

Time Processing: Dynamic, time-step model.

Treatment of Randomness: Threats and surveillance architecture deterministically set. Environment and noise for sensor and signal processing stochastically set. Surveillance algorithms output based on single run of each time event.

Sidedness: One-sided.

LIMITATIONS: Does not model weapon target assignment functions. Does not currently contain laser signature or sensor models.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of active Infrared (LADAR) model, additional backgrounds, and refining the baseline surveillance algorithms (test articles).

INPUT: Threat, Environment, Architecture Definitions, Communications & Data Processing Characterizations, and Surveillance Algorithms.

OUTPUT: Produces plots and printouts of selected surveillance systems measures of performance and surveillance algorithms scoring.

HARDWARE AND SOFTWARE:

Computer:	Initial operating capability (IOC) testbed is designed to be hosted on a uni-processor VAX 8800 running under the VMS operating system. Required support computers: MicroVAX 3400, Advanced Sensor Emulation Unit, Advanced Sensor Signal Processing Unit, Silicon Graphics.
Storage:	256 megabytes memory (minimum). 10 gigabytes disk storage (primarily for data base storage.)
Peripherals:	1 color laser printer, 4 ASCII terminals.
Language:	Ada, FORTRAN, C, Assembly.
Documentation:	Documentation includes STB Program Plan, Requirements, Top-Level Design, Experimentation Plan, & Validation Plan.

SECURITY CLASSIFICATION: Unclassified code and framework with some classified inputs, data bases, and outputs. Procedures for competition sensitive or classified surveillance algorithms to be hosted on the test bed are available.

GENERAL DATA:
Data Base: Population of large data bases can take several man-months.

CPU time per Cycle: Highly dependent on scenario run and data base size. Large exercises can take 40 hours of CPU time to process a half-hour of the selected scenario.

Data Output Analysis: Silicon graphics computer/workstations aids in preprocessing and postprocessing analysis of output. Produces hardcopies of raw and processed data.

Frequency of Use: Continuous use.

Users: SDIO, GE Aerospace in support of the System Engineering & Integration Contract, Element Program Offices, USASDC, USAF/SSD.

Comments: Managed by SDIO. Development currently being coordinated by USASDC. IOC delivery October 1991 with upgrades throughout 1992.

TITLE: STEWS - Simulation of Total Electronic Warfare Systems.

DATE IMPLEMENTED: 1973.

MODEL TYPE: Analysis.

PROPONENT: Naval Research Laboratory, Code 5707, Washington, DC 20375-5000.

POINT OF CONTACT: Mr. S. Leroy, (202) 767-2013, AV 297-2397.

PURPOSE: STEWS evaluates ESM systems effectiveness in medium-scale to large-scale electromagnetic environments. It is a research and evaluation tool that emulates EW receivers.

DESCRIPTION:
Domain: Land, sea, and air in any combination.

Span: Local and regional.

Environment: Land masses with no terrain; seas, but no sea states.

Force Composition: Platforms, missiles, and RED and BLUE emitters.

Scope of Conflict: Purely electromagnetic environments including surveillance radars, jammers, decoys, etc.; no EO/IR or hard kill weapons.

Mission Area: Outer air battle into inner defense zone.

Level of Detail of Processes and Entities: Platforms and missiles move about in 3-D space according to planned tracks. Antennas rotate or scan electronically. Emitters turn on and off and can be represented down to the pulse level. ESM simulations can perform as superheterodyne receivers, IFMs, crystal video, radars, etc. Level of detail is either signal level or pulse-by-pulse. Library functions perform threat ID. Associated EW system displays and dynamic scenario displays run simultaneously on RAMTEKs to allow for man-in-the-loop interaction.

CONSTRUCTION:
Human Participation: Not required, but can be introduced via the EW system operator interfaces if desired without model interruption.

Time Processing: Dynamic; some ESM systems may use fixed time-steps, others are variable time-steps caused by behavioral response of EW system to the current events. Other systems, such as radars, can be ratio-adjusted to maintain a fixed wall clock time to game time ratio.

Treatment of Randomness: Environment building process is either deterministic or stochastic in determining initial platform positioning, antenna pointing, emitter parameter values, etc. Emitter parameter measurements of ESM system models may be stochastic. All stochastic processes are performed via draws from pseudorandom number sequences. All runs are repeatable given the same seeds.

Sidedness: Two-sided, asymmetric, one side (the environment) nonreactive. ESM system to ESM system can be two-sided, symmetric.

LIMITATIONS: No terrain features currently in scenarios, no atmospheric effects, and no flat earth approximation for range calculations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Introduction of DTED and sea state for multi-path and line-of-sight calculations; ellipsoid and spherical earth models for long-range calculations; atmospheric effects on propagation; speedup of ESM models to run the STEWS Operational Situations Simulations (SOS) in real time; redirection of platforms and missiles in SOS runs to have two-sided, symmetric sidedness; and hard kill models to allow for attrition contribution of such weapons.

INPUT: STEWS scenarios; detailed ESM system characteristics of the processing and intercepting logic of the receivers; and inputs of the frequency coverage, sensitivity, timing characteristics of various functions, etc.

OUTPUT: All printed output, including histories, emitter summary reports, reports broken down by frequency coverage bands, and random files containing all required emitter events for postprocessing by Model Analysis Programs (MAPS), is optional. Scenario analyses provide hardcopy and plots of pulse densities and scenario dynamics.

HARDWARE AND SOFTWARE:

Computer:	VAX computer with VMS; may run on a VMS clone.
Storage:	STEWS software approximately 35,000 blocks. Individual ESM system models typically 10,000 - 15,000 blocks.
Peripherals:	Minimum 1 high-speed printer (1200 LPM); 2 VT100, VT200, or VT300 series terminals; 1 Tektronix 4014, 4016, or 4125 series terminal; 2 RAMTEKs for ESM system displays.
Language:	VAX FORTRAN.
Documentation:	17 documents plus any new issues as available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Several man-months to several man-years to collect scenario intelligence. ESM information depends on availability of specs or vendor.

CPU time per Cycle: Depends on scenario size and level of detail of each ESM simulation; can vary from wall clock time to scenario time ratio of 1:1 to 300:1 (300:1 in the case of very fine level of detail simulations with heavy message passing across a DECNet network) on VAX 8650s.

Data Output Analysis: APS analyses, scenario analyses, and scenario utilities produce a wide variety of hardcopy and graphics output.

Frequency of Use: Approximately 700 times per year.

Users: Only users of current software are PRL and MITRE Corp.; DREO Canada; DRCS Australia; AFAL WPAFB and EWL, Ft. Monmouth, use earlier versions.

Comments: STEWS Version 2.2 is continually upgraded, debugged, etc.

TITLE: STOCHADE.

DATE IMPLEMENTED: N/A.

MODEL TYPE: Analysis.

PROPONENT: MA Department, RARDE (Fort Halstead,) Sevenoaks, Kent, U.K.

POINT OF CONTACT: System Assessment Group, Royal Military College of Science (0793) 785285.

PURPOSE: STOCHADE is a fast, highly aggregated model of heterogeneous direct-fire battle used as a research tool or as support for a higher-level game.

DESCRIPTION:
Domain: Abstract; generally taken to be land.

Span: Local or regional.

Environment: N/A.

Force Composition: Mixed force of direct-fire weapons.

Scope of Conflict: Conventional.

Mission Area: N/A.

Level of Detail of Processes and Entities: Individual weapons aggregated into groups of weapons of different types.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Two versions exist. The deterministic version is time-step, and the stochastic version is event-step.

Treatment of Randomness: Deterministic model uses solution of a system of Lanchester-type differential equations. Stochastic version is a simulation solution of the stochastic equivalent of the deterministic equation.

Sidedness: Two-sided, symmetric.

LIMITATIONS: STOCHADE is a highly aggregated model in which ranges of engagement are modeled according to the "centers of gravity" of the force.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Numbers of each weapon type, kill rates, speed of advance, target selection rules, intervisibility and detection probabilities, fractional kill rate capabilities for moving weapons and targets, and proportion of fire on dead or false targets.

OUTPUT: In the deterministic version it is the number of survivors of each weapon type as a function of time and range. In the stochastic version (optional), for each run, the output consists of casualties, target weapon, firing weapon, and battle time order of kill.

Program routine: A summary of a number of replications gives the following: number of RED and BLUE wins with 95% confidence intervals; average time of battle, average time for RED win, average time for BLUE win (all with standard deviations); mean and standard deviation of number of RED and BLUE survivors for each weapon type; and frequencies and histograms of numbers of survivors for each weapon type.

HARDWARE AND SOFTWARE:

Computer: A Hewlett Packard 9835A desktop computer and VDU, with optional disk-drive, printer, and graph plotter; VAX 11/750 at RARDE.

Storage: N/A.

Peripherals: N/A.

Language: Hewlett Packard Extended BASIC and VAX FORTRAN at RARDE.

Documentation: User guide, program listing, and model descriptions.

SECURITY CLASSIFICATION: N/A.

GENERAL DATA:

Data Base: Minutes to input data.

CPU time per Cycle: Depending on data, 3-15 seconds per replication.

Data Output Analysis: N/A.

Frequency of Use: Continuous at RARDE.

Users: RARDE and RMCS.

Comments: N/A.

TITLE: STRAPEM - Strategic Penetration Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAS), Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Capt. Conley DSN 227-9795 or Commercial (703) 697-9795.

PURPOSE: STRAPEM simulates the effectiveness of a force of air breathing vehicles penetrating a defended airspace.

DESCRIPTION:

Domain: Land and air.

Span: Theater/regional.

Environment:

Force Composition: Scenario dependent. Offensive forces include penetrators, penetrator weapons (bombs, SRAMS, and cruise missiles), and tankers. Defensive forces include SUAWACS, EW/GCI radars, SAMs, airborne interceptors (AIs), targets, and command and control.

Scope of Conflict: Conventional and nuclear.

Mission Area: Low observable aircraft and ability of AIs and SAMs to intercept penetrating aircraft.

Level of Detail of Processes and Entities: Scenarios can include 1-2 penetrating aircraft up to SIOP-like campaign. A list of 100 different events can occur during a simulation run. Penetrator probability to penetrate and probability of survival are Monte Carlo based.

CONSTRUCTION:

Human Participation: Required for decisions.

Time Processing: Dynamic time- and event-stepped.

Treatment of Randomness: Deterministic and probabilistic (Monte Carlo based).

Sidedness: One-sided.

LIMITATIONS: 1) No capability to explicitly model the effects of ECM against the EW/GCI net. 2) Ground-based defenses cannot move during the simulation. 3) Low fidelity modeling of in-flight refueling. 4) Penetrator fuel not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None. The model was written in 1982 and several upgrades have been made since then.

INPUT: Offensive force structure and mission plans, tactics guidelines, radar performance factors, defensive beddowns (AIs, SAMs, SUAWACS, and EW/GCI radars).

OUTPUT: The primary output is a list of 100 different events that can occur during a simulation run. Postprocessors calculate the primary output statistics -- probability to penetrate, probability of survival, and time in coverage.

HARDWARE AND SOFTWARE:
Computer: VAX and UNIX systems.
Language: FORTRAN 77.
Documentation: Users Guide and Analyst Manual available from OPR.

SECURITY CLASSIFICATION: Unclassified (without data base).

GENERAL DATA:
Data Base: Starting a data base from scratch for a simple case takes about a week. For a SIOP-like scenario, data base development can take several man-months. However, once basic data bases are built, excursions are easy to accomplish without modification to the data base.

CPU time per Cycle: Scenario dependent. Runs with five penetrators take 2-3 minutes. A simulation of a SIOP-like scenario takes 2-10 hours.

Data Output Analysis: Scenario dependent.

Frequency of Use: Daily.

Users: AFSAA/SAS, Boeing, The RAND Corporation, The Institute for Defense Analysis, Northrop, AFSC/FTD, AFSC/ASD.

TITLE: STRATC^{2}AM - Strategic Command & Control Architecture Model.

DATE IMPLEMENTED: Unknown.

MODEL TYPE: Analysis. Research and evaluation tool which deals with force capability and requirements.

PROPONENT: Air Force Center for Studies & Analysis (AFCSA), The Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Lt Col L. Clark, AV 227-9408, Commercial (202) 697-9408.

PURPOSE: STRATC^{2}AM analyzes multimessage command, control, and communications (C^3) networks in ambient and stress environments.

DESCRIPTION:

Domain: Land, sea, air, space, and undersea.

Span: Accommodates any theater depending on the data base.

Environment: Models day and night communication links between nodes in both nuclear stressed and ambient environments.

Force Composition: Accommodates any force structure depending on the data base, including Blue and Red.

Scope of Conflict: Primarily nuclear effects on communication link.

Mission Area: Emergency Action Message dissemination to SIOP forces throughout the world.

Level of Detail of Processes and Entities: STRATC^{2}AM is a data-base-driven, Monte Carlo simulator of C^3 networks. The model consists of an interactive preprocessor which uses a query response format for data input, and a simulator which uses the preprocessor data file and simulates the performance of the prescribed C^3 network under specified scenario environments. The simulator performs propagation calculation and collects statistical data for various Monte Carlo trials. The model's postprocessor reduces data collected by the simulator and displays the results for analysis.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, event-stepped model.

Treatment of Randomness: Stochastically based on direct computation of probability of detection and probability of kill, with Monte Carlo determination of result.

Sidedness: Two-sided, symmetric model.

LIMITATIONS: 500 C^3 nodes, 10 messages, and only looks at high altitude nuclear bursts.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Converting preprocessor to PC-based, adding Threat Assessment Module, improving LF/VLF and HF modeling for future versions.

INPUT: Very user dependent! Communication equipment specifications (modulation, frequency, power, etc.), message networking (routing of message path), and scenario (jammers, nuclear bursts).

OUTPUT: 13 separate statistical reports based on the simulation of the networks performance (i.e., Probability of Correct Message Receipt).

HARDWARE AND SOFTWARE:
- Computer: IBM 3090 or 9021-270.
- Storage: Executable Code = 28M and Source Code = 70K.
- Peripherals: Minimum requirements: 1 printer and 4 IBM 3192F terminals.
- Language: FORTRAN V.
- Documentation: Nonexistent.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Preparation varies dependent on data base size.

CPU time per Cycle: Dependent on data base size and player configuration. Entire C^3 connectivity network from message originator down to individual TRIAD force elements can take up to 2 hours (simulator) and 10 minutes (postprocessor) time.

Data Output Analysis Postprocessor aids in analysis of output.

Frequency of Use: Daily.

Users: Joint Strategic Target Planning Staff, Air Force, OSD (PA&E), contractors supporting those agencies.

Comments: Updated through Science Applications International Corporation.

TITLE: STRAT DEFENDER 2.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: Global Forces Division, Air Force Studies and Analyses Agency (AFSAA/SAS), The Pentagon, Room 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. D. Clements, DSN 227-9430, Commercial (703) 697-9430.

PURPOSE: STRAT DEFENDER 2 is an event-oriented, Monte Carlo simulation of a strategic defense system interacting with a deterministic attacking force of bombers, and air-to-surface and cruise missiles. It is primarily an operations support tool. This model was originally developed at HQ NORAD and modified for AFSAA/SAS use.

DESCRIPTION:

Domain: Land, air and space.

Span: Global.

Environment: Radar: Largely smooth earth, except in detailed AWACS modeling where limited background types are used. Infrared: Three types of earth background: land, water, and snow. Each type has an associated emissivity. Clouds are modeled by giving cloud heights at one-degree latitude and longitude increments around the globe.

Force Composition: RED strategic air-breathing forces versus BLUE defensive forces, including ground radars, AWACS, space-based sensors, fighter interceptors, and SAMs.

Scope of Conflict: Nuclear.

Mission Area: Strategic nuclear bombardment.

Level of Detail of Processes and Entities: STRAT DEFENDER 2 simulates the movement of bombers, air-to-surface missiles, and cruise missiles over a spherical earth as well as their interaction with a defense network. Interceptors are committed from bases or orbit points on a variety of intercept profiles including aircraft fuel monitoring and reattack logic of the profiles selected. End-game actions of detection, conversion, and missile kill are modeled stochastically.

CONSTRUCTION:

Human Participation: Required for building attack plan and locating defensive forces. However, humans do not intervene in the simulation once it has begun.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Uses both deterministic and stochastic techniques. Events such as entering into and exiting out of radar and SAM coverage and fighter commitment result from geographic and spatial relationships. However, kills by fighters and SAMs, flight maintenance requirements, and certain time delays are stochastically represented.

Sidedness: Two-sided, asymmetric. Defensive forces can react to the emerging battle, but penetrators must follow preplanned routes.

LIMITATIONS: Terrain is not modeled, and command and control connectivity is considered complete with some delays.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: RED attacking force data, including flight routes and their characteristics (speed and altitude); penetrator signatures, both radar and infrared; and target locations. BLUE defensive force data, including fighter and SAM orders-of-battle, fighter and SAM performance data, radar performance data, and rules of engagement.

OUTPUT: Printed listing of events as they occurred in time. Further, each type of event can be saved in its own history file as it occurs. Summary data includes the number of penetrators killed by type, fighter maintenance statistics, and radar detection statistics.

HARDWARE AND SOFTWARE:

Computer:	IBM 3090 MVS/XA.
Storage:	At least 700 KB, with more required if input data amounts increase.
Peripherals:	Standard mainframe input and output devices.
Language:	SIMSCRIPT II.5.
Documentation:	User's manual, programmer's manual and analyst's manual.

SECURITY CLASSIFICATION: Model without data is unclassified.

GENERAL DATA:

Data Base: Depends on scenario.

CPU time per Cycle: From 20 seconds to 1 hour, depending on the scenario.

Data Output Analysis: Depends on scenario.

Frequency of Use: Based on STRAT DEFENDER 2 involvement in studies.

Users: AFSAA/SAS, DCA/DSSO/JNSV, ANSER Corporation, and others.

Comments: DCA/DSSO/JNSV is under contract for STRAT DEFENDER III, which used this model as a foundation.

TITLE: Strategic Allocation Model.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: Avtec Systems, Inc., 10530 Rosehaven St., Fairfax, VA 22030. (under contract to Chief of Naval Operations, NAVOP 654, BE781, The Pentagon, Arlington, VA 20350).

POINT OF CONTACT: Dr. Kenneth D. Shere, (703) 273-2211.

PURPOSE: The Strategic Allocation Model is used to evaluate the effectiveness of the SSBN forces in terms of damage to the target base. Various types of ASW and ABM are taken into account. Other parameters include operating areas, the target base and weapon loading.

DESCRIPTION:

Domain: Sea, air, space and land.

Span: Global.

Environment: N/A.

Force Composition: Red: ASW forces and ABM forces with some intelligence added; Blue: SSBNs and SLBMs.

Scope of Conflict: Strategic.

Mission Area: Strategic Nuclear Warfare.

Level of Detail of Processes and Entities: Individual submarines and ASW assets are allocated to known operating areas. Weapon loading allocated to submarine classes. Target base is allocated to specific hard target and soft target cells. ABM assets are allocated to cells or combinations of cells.

CONSTRUCTION:

Human Participation: Required to specify parameters such as the target base and location and size of operating areas.

Time Processing: Permits attacks to occur in waves.

Treatment of Randomness: This model is deterministic and provides expected values; search routines are used in the optimization process which allow the analyst to evaluate the variation or "smoothness" associated with the optimal solution.

Sidedness: Two-sided, asymmetric, reactive. A double optimization process is used. Red reacts to Blue submarine allocation. Blue targeting reacts to Red ASW. Red ABM reacts to Blue targeting.

LIMITATIONS: None from a theoretical viewpoint. Limited by computation time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model is currently being used and continues to be updated to reflect the current ASW threat and weapon and system capabilities.

INPUT: Input parameters include the target base, operating areas, and weapon and ASW characteristics. Also input are the total number of submarines by ocean and the total ASW and ABM resources.

OUTPUT: Surviving number of hard targets and surviving percentage of the soft targets are output, together with the allocation of the submarines to operating areas and weapons to targets. The ASW allocation is also output.

HARDWARE AND SOFTWARE:

Computer: This model has run on CDC Cyber 170, Sun Sparc workstations, IBM 386 and 486 compatible microcomputers, and the Alliant.

Storage: When the full model with ABM is running, it may be necessary to use a machine equivalent to an Alliant.

Language: The code is written in FORTRAN 77. It should run on any machine having a FORTRAN 77 compiler.

Documentation: A technical report that describes the model and a user manual exist. These are available from Avtec Systems, Inc. with permission from CNO-NOP654, or directly from CNO-NOP654.

SECURITY CLASSIFICATION: Unclassified. The data used in this model are classified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Dependent on the specific problem addressed.

Data Output Analysis: Not applicable. Generally done manually. Future modifications will include more graphics.

Frequency of Use: Over a period of years it is sporadic. When specific reports are needed about 40-50 runs over 1-4 days are made. The model is enhanced regularly to address specific issues.

Users: Chief of Naval Operations.

TITLE: Strategic Defense Capability Calculator.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: HQ USAF/XOXWF.

POINT OF CONTACT: LTC Ronald Trees, DSN 225-1535, Commercial (703) 695-1535.

PURPOSE: The strategic defense model is used primarily to analyze strategic level operations plans for the defense of the continental US. It is specifically designed to serve as both an operations support and a force capability tool to assess the relative values and capabilities of planned and proposed strategic defense systems. Systems are divided into three subareas of analysis: ballistic missile warning systems, space surveillance systems, and strategic air defense systems.

DESCRIPTION:
Domain: Space, air.

Span: Accommodates largely the CONUS theater regarding ballistic missile warning and strategic air defense. Space surveillance submodel covers most of global exoatmospheric domain.

Environment: Environmental details are not significant in the models calculations.

Force Composition: Incorporates Red force mix. Capabilities of Blue force mixes can be analyzed as groups, subgroups, or as individual systems.

Scope of Conflict: Ballistic Missile Warning Model weapons categories limited to early warning and detection of Red nuclear attack; Space Surveillance is limited to observation of enemy satellite threat; Air Defense Model concerns conventional fighter response to Red bomber/ALCM attack.

Level of Detail of Processes and Entities: Lowest level of entities modeled for Ballistic Missile Warning and Space Surveillance sub-models are major mission-design series and proposed modifications. Air Defense sub-model level is at individual anti-aircraft missiles and proposed modifications in hardware.

CONSTRUCTION:
Human Participation: Not required or permitted during model run, but run is interruptable.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model terrain.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Scenario development requires system force structure, weapon system capabilities, probabilities of an attack, and enemy threat laydown.

OUTPUT: Likelihood of detecting and intercepting enemy threats.

HARDWARE AND SOFTWARE:

Computer: Designed to run on a PC.
Storage: 640K RAM and 10Meg of hard disc space.
Peripherals: One printer.
Language: Microsoft PASCAL.
Documentation: User's manual and functional description.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of large data bases can take several man-days.

CPU time per Cycle: Under five minutes using an 80286 PC.

Data Output Analysis: Produces hardcopy of raw data. Requires a trained analyst to interpret some data.

Frequency of Use: Several times per year.

Users: HQ USAF/XOXWF.

Comments: None.

TITLE: STRAT PATROLLER Model.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SASS), The Pentagon, Room 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Capt Dave Goss, AFCSA/SASS, (703) 697-6086, AV 227-6086.

PURPOSE: STRAT PATROLLER analyzes interceptor detection capability.

DESCRIPTION:
Domain: Air.

Span: Global.

Environment: Radar: Largely smooth earth with some ground clutter. Infrared: Temperature, humidity, visibility, and percent cloud cover used to represent the atmosphere.

Force Composition: RED strategic air-breathing forces vs. BLUE defensive fighter forces.

Scope of Conflict: Conventional.

Mission Area: Strategic nuclear bombardment.

Level of Detail of Processes and Entities: STRAT PATROLLER models the scanning process of fighter radar antennas and infrared search sets; the detection capability of those radars, infrared search sets, and the aircrew; and the radar, infrared, and visual observable characteristics of penetrator aircraft and cruise missiles. Noise jamming and chaff are also modeled. STRAT PATROLLER allows fighter orbit shapes and sensor search patterns to be varied on each leg of the orbit to analyze the detection capability of a given interceptor aircraft against a given threat.

CONSTRUCTION:
Human Participation: Required for building attack plan and locating defensive forces. However, humans don't intervene in the simulation once it has begun.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Uses both deterministic and stochastic techniques. Events such as entering into and exiting out of radar and SAM coverage and fighter commitment result from geographic and spatial relationships. However, detecting penetrators is a random process driven by the detection probability they accumulate as they transit their flight paths.

Sidedness: Two-sided, symmetric. Defensive forces can react to the emerging battle, but penetrators must follow preplanned routes.

LIMITATIONS: Terrain is not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: RED attacking force data, jamming and chaff conditions, interceptor orbit parameters, and detailed radar and infrared performance data.

OUTPUT: Selective levels of output detail are possible through a series of key words. Probability of detection for specific scenarios is the primary output of this simulation.

HARDWARE AND SOFTWARE:
- Computer: IBM 3081 with MVS/XA.
- Storage: At least 100 KB, with more required as the amount of input data increases.
- Peripherals: Standard input and output devices.
- Language: SIMSCRIPT II.5.
- Documentation: User's manual, analyst's manual, and programmer's manual.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:

Data Base: Depends upon scenario.

CPU time per Cycle: Depends upon scenario.

Data Output Analysis: Depends upon scenario.

Frequency of Use: Twice per year.

Users: SASS.

Comments: None.

TITLE: STRAT RANGE.

DATE IMPLEMENTED: 1976.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SASB).

POINT OF CONTACT: Lt Col Remington, AFCSA/SASB, ext. 79748.

PURPOSE: STRAT RANGE calculates single sortie strategic bomber aerial refueling support requirements.

DESCRIPTION:

Domain: Air.

Span: Global.

Environment: All weather.

Force Composition: BLUE.

Scope of Conflict: Strategic nuclear.

Mission Area: Strategic nuclear (air-breathing).

Level of Detail of Processes and Entities: The entity is a single aircraft. The processes are bomber missions supported defined in terms of mission segment distances and payload.

CONSTRUCTION:

Human Participation: Required for decisions; model waits for decisions.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: One-sided.

LIMITATIONS: Time consuming.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modify to read batch files and output to printer or disk.

INPUT: Bomber type, payload configuration, fuel load, and flight profile are input along with the type of tanker.

OUTPUT: Using MS-DOS print screen command, full or abbreviated printouts are available giving bomber flight distance, fuel remaining, and gross weight for each leg of the flight profile. Aerial refueling demand is noted in fractions of tankers.

HARDWARE AND SOFTWARE:

Computer:	IBM compatible/DOS.
Storage:	Floppy disk.
Peripherals:	Screen output.
Language:	FORTRAN.
Documentation:	Limited.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: From one week to two months.

CPU time per Cycle: On the order of a few seconds per sortie run.

Data Output Analysis: Minimal.

Frequency of Use: As needed.

Users: AFCSA/SASB, Rand, and Northrop.

Comments: None.

TITLE: STRAT SURVIVOR.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SASB), The Pentagon, Room 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Maj Rolando, AFCSA/SASB, (703) 697-9804, AV 227-9804.

PURPOSE: STRAT SURVIVOR is used to analyze the strategic base escape problem.

DESCRIPTION:

Domain: Land and air.

Span: Regional.

Environment: Gust effects have been added to the model, but the changes to the model have not been validated.

Force Composition: BLUE ground alert aircraft escaping from a pattern attack by RED submarine-launched ballistic missiles.

Scope of Conflict: Strategic nuclear.

Mission Area: Strategic nuclear (air-breathing).

Level of Detail of Processes and Entities: The model uses simplified descriptions of aircraft performance and vulnerability and relatively comprehensive damage algorithms based on the "DIA Physical Vulnerability Handbook" equations, the cumulative log-normal distribution, and algorithms developed by the Air Force Weapons Laboratory. The potential kills are summed and weighted to form an aggregation value matrix. The optimum weapon allocation is then selected using a standard transportation problem solution technique in a combination of base-by-base and missile round-by-round optimization. The model will allocate multiple missiles on a target when it is feasible and profitable.

CONSTRUCTION:

Human Participation: Not known--individual who maintained the model is no longer in SA, and the model has not been used for several years.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: One-sided.

LIMITATIONS: Much of the optional output is inaccessible and much of the existing output is inexplicable. The model has not been validated since the last changes.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Aircraft characteristics, threat data (types and locations of submarines), and offensive and defensive tactics data. The beddown can be scenario-optimized if desired.

OUTPUT: Surviving aircraft are summarized by individual aircraft, aircraft type, base, and submarine. Optional outputs include peak overpressure and thermal levels experienced by individual aircraft and plots of aircraft paths and weapons DGZs.

HARDWARE AND SOFTWARE:
- Computer: IBM 3081 with MVS.
- Storage: N/A.
- Peripherals: N/A.
- Language: FORTRAN.
- Documentation: Analysts' manual, users' manual, and programmers' manual.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Two weeks.

CPU time per Cycle: Thirty minutes.

Data Output Analysis: One hour (per set of replications).

Frequency of Use: Not currently used.

Users: Last known users: AFCSA/SASB.

Comments: None.

TITLE: Strike.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: Strike models multi-aircraft strikes against defended land targets. It is designed to support battle damage assessment in conjunction with larger war games.

DESCRIPTION:

Domain: Land.

Span: Local.

Environment: N/A.

Force Composition: Strike aircraft, air- and ground-based defenses.

Scope of Conflict: Conventional strike and AAW.

Mission Area: Strike warfare, AAW.

Level of Detail of Processes and Entities: User defines geographic area, strike composition, armament and flight profiles, defender air- and ground-based AAW defense locations and composition.

CONSTRUCTION:

Human Participation: Required for initial inputs only.

Time Processing: Closed form.

Treatment of Randomness: Outcomes stochastically based on direct computation of probabilities, with Monte Carlo determination of result.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Only useful for specific engagement vice aggregated results. User input-intensive.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Map and target locations, strike composition and armament, location, composition and armament of air- and ground-based defenses.

OUTPUT: Cumulative detections, aircraft losses by aircraft type, weapons expenditures, percentage target damaged/destroyed report.

HARDWARE AND SOFTWARE:

Computer: IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: Printer.
Language: "C."
Documentation: User's manual, design description, source code.

SECURITY CLASSIFICATION: Unclassified, but data base is classified.

GENERAL DATA:

Data Base: One hour.

CPU time per Cycle: N/A.

Data Output Analysis: None.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: Strike is designed to be used in conjunction with the Kinematics and Surface-Air Battle models. Data bases are compatible. Users should be able to move freely among all three models. Strike may be used independently to provide battle damage assessment information in support of larger war games.

TITLE: STRIKER - Tomahawk Land Attack Effectiveness Simulation.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: McDonnell Douglas Missile Systems Company, P.O. Box 516, St. Louis, MO 63166.

POINT OF CONTACT: John Fox, (314) 233-0663.

PURPOSE: STRIKER models a BLUE force of cruise missiles and tactical aircraft that attack land targets and land-based RED force defensive systems. It analyzes the survivability and effectiveness of the BLUE force in support of engineering analyses for weapon system development, and the development of tactical doctrine, such as the effectiveness of a mix of weapon systems against targets.

DESCRIPTION:

Domain: Air, land, and sea.

Span: Theater or regional.

Environment: Any land area for which digital terrain elevation data is available.

Force Composition: BLUE force cruise missiles and tactical aircraft. RED force ground targets, SAM sites, and AAA sites.

Scope of Conflict: Conventional weapons.

Mission Area: Defense suppression and target damage.

Level of Detail of Processes and Entities: Missiles (BLUE and RED), aircraft, and air-to-ground weapons (HARM, bombs, Walleye, Tacit Rainbow) are represented individually and are modeled with three or more degrees of motion. Radar performance models include radar range equation, multipath, ground clutter, and terrain masking. The Tomahawk cruise missile model uses real Tomahawk elevation guidance logic. HARM and Tacit Rainbow models include all guidance and attack logic modes. Attrition stops motion. Damage to a necessary component suppresses a system. For example, the loss of a SAM site radar suppresses the site.

CONSTRUCTION:

Human Participation: User plans scenario and creates input files. Scenario parameters are not modified during a simulation run (runs with or without graphics). During a graphics run, user can stop and restart simulation, adjust running speed, and zoom and pan display.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric. RED force is reactive, BLUE force is partly preplanned and partly reactive.

LIMITATIONS: Maximum of 100 cruise missiles, 50 BLUE aircraft, 200 ground targets, 100 SAM sites, and 200 AAA guns at 20 sites. These are compile-time parameters, which can be easily adjusted.

PLANNED IMPROVEMENTS AND MODIFICATIONS: RED force additions: early warning radars, filter centers, command and control, AWACS, GCI radars, interceptor aircraft. BLUE force additions: SLAM, laser-guided bombs, decoys.

INPUT: Digital terrain elevation data, BLUE and RED force weapon characteristics, cruise missile mission plans, BLUE aircraft flight plans, Tacit Rainbow mission plans, RED defense site locations, SAM site firing doctrine and sector options, and weaponeering inputs for target damage simulation.

OUTPUT: Dynamic color graphics display of strike area showing moving vehicles, targets, and flight plans; dynamic text display showing summary of RED and BLUE kills; dynamic text display of information about one user-selected vehicle; and computer file outputs with target damage assessment, BLUE force attrition, RED force attrition, and detailed time history of events.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS.
Storage:	Approximately 5 MB of main (virtual) memory, 100,000 blocks of disk storage, plus DTED data (5700 blocks per area of 1 degree latitude by 1 degree longitude).
Peripherals:	Tektronix 4115 or 4125 graphics terminal.
Language:	FORTRAN 77 with DEC extensions.
Documentation:	Simulation catalog entry (21 pages), model description (89 pages), user manual (60 pages).

SECURITY CLASSIFICATION: Secret. (Nearly all code is unclassified, but a small number of subprograms are secret or confidential.)

GENERAL DATA:

Data Base: Two to four weeks for a new scenario; less if working from an existing scenario.

CPU time per Cycle: Depends on scenario size. One case of 25 cruise missiles, 29 SAM sites, and 17 AAA sites took 62.5 CPU minutes for 25 Monte Carlo iterations.

Data Output Analysis: Depends on the intent of the analysis. A data reduction program is available to select, sort, and summarize event file data.

Frequency of Use: Used monthly.

Users: Used internally by McDonnell Douglas. Programs include Tomahawk, Cruise Missile Mission Planning, Advanced F/A-18, Tacit Rainbow, SLAM, AIWS.

Comments: Utilizes radar performance data generated by SALRAM, another McDonnell Douglas simulation. Enhancements are ongoing.

TITLE: Sub-on-Sub.

DATE IMPLEMENTED: 1987

MODEL TYPE: Training and education.

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: Sub-on-Sub models submarine versus submarine detections and engagements. It is designed to support battle damage assessment in conjunction with larger-scale war games.

DESCRIPTION:
Domain: Sea.

Span: Individual.

Environment: Season/month, location, ocean area, sea state, shipping density.

Force Composition: Individual BLUE and RED submarines.

Scope of Conflict: Conventional sub-ASW weapons.

Mission Area: ASW.

Level of Detail of Processes and Entities: User specifies BLUE and RED submarine mission type and disposition (aggressive or evasive), platform class, and sensor and weapon types. Highly detailed detection and engagement models.

CONSTRUCTION:
Human Participation: Required for initial inputs only.

Time Processing: Static.

Treatment of Randomness: Outcomes stochastically based on direct computation of probabilities, with Monte Carlo determination of result.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Only useful for very small engagement (i.e., one sub versus one sub). Output insufficiently detailed for analysis.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Update platform, sensor, and weapon parameters.

INPUT: Environment, BLUE/RED missions, platforms, sensors, weapons, countermeasure effectiveness.

OUTPUT: BLUE/RED detection MDRs, probabilities of detection, attack/closure, kill and reattack, and mean and random probability values.

HARDWARE AND SOFTWARE:

Computer:	IBM-compatible PC with 512K RAM.
Storage:	N/A.
Peripherals:	N/A.
Language:	BASIC.
Documentation:	User's manual, design description, program code.

SECURITY CLASSIFICATION: Unclassified but data base is classified.

GENERAL DATA:

Data Base: Done by contractor.

CPU time per Cycle: About 45 seconds.

Data Output Analysis: None.

Frequency of Use: 15-20 times per year.

Users: Wargaming Department, Naval War College.

Comments: None.

TITLE: Suppressor.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Combat Office (AFECO), Wright-Patterson AFB, OH 45433.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The Suppressor Simulation System is an appropriate tool for evaluating different weapon systems, sensor systems, tactics or command procedures in composite Electronic Combat missions against an integrated air defense.

DESCRIPTION: The Suppressor digital computer model is an event-stepped, player-oriented, general-purpose simulation of a possible multi-sided conflict involving some combination of air, ground, naval, and space-based force structures.

LIMITATIONS: 1) Limited input error checking; 2) On large scenarios: storage and CPU time.

INPUT: 1) Type Data Base (TDB), contains the characteristics and capabilities of the players, including their tactics; 2) Scenario Data Base (SDB), describes the relationships among the players: their locations, command and control links, communication nets, etc.; 3) Environment Data Base (EDB), defines the terrain surface for the LOS calculations for sensors, communications equipment, and radar/radio jammers.

OUTPUT: 1) Screen display resembling a scoreboard during execution; 2) Text file containing a time line of user-selected events; 3) A binary file containing a snapshot of the scenario at end-of-game.

HARDWARE AND SOFTWARE:

Computer:	VAX (with minor documented changes, can be placed on IBM, PC, UNIX machines)
Storage:	3.4 Mbytes Disk Storage on VAX without input files. 4-6 Kbytes/Player plus Terrain Data. Necessary Executable Memory.
Language:	FORTRAN.
Documentation:	Installation and Use; Input Data Item References; Example User Instructions; Model Responses

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:

Time Requirements: Compilation time: Machine dependent; Typical run time: Scenario dependent (with minimal number of moving systems will run close to real time).

Users:

513 TESTS/TEOE
544 CAS/CAOP
6510 TW/TSDE
AD/ENYS
AFCSA/SASB
AFECO/ET
AFOTEC/OAN
AIL Systems Inc.
ASD/ENAMA
ASD/ENS
ASD/ENSSE
ASD/XRM
ASDI
Alphascience
Amherst System Inc.
Analytic Services Inc.
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Boeing Aerospace Company
Boeing Military Aricraft Company
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
C3CM Joint Test Force/OAM
CAE Link Flight Simulation
Calspan Corporation
Cambridge Research Associates, Inc.
Computer Sciences Corporation
Dalmo Victor Inc., The Singer Company
Defense Development Corporation
E-Systems, Greenville Division
ENYS
FTD/TQIO
FTD/TTISO
GTE Government Systems Corporation
General Dynamics Corporation
General Dynamics/Convair Division
General Dynamics/Electronics Division
General Research Corporation
Georgia Institute of Technology
Gould (NAVCOM)
HQ SAC/XPSS
HQ USAFTAWC/ECAO
HQS USAF/SAGR
Hughes Aircraft Company - Radar Systems Group
Institute for Defense Analyses
JEWC/CA
JEWC/TAE
Johns Hopkins Univ. Applied Physics Lab.
KAMAK Research Corporation
LTV Aircraft Products Group
LTV Missiles and Electronics Group
Link Flight Simulation Corporation
Litton/Applied Technology
Lockheed - Aeronautical System Company
Lockheed - Georgia Company
Lockheed Aircraft Services Company
Logicon, Inc.
Loral Advanced Projects
Loral Electronic Systems

MacAulay-Brown Inc.
Martin Marietta - Orlando Aerospace
Martin Marietta Simulation Systems Division
McDonnell Aircraft Company
McDonnell Douglas Aircraft Company
Merit Technology Inc.
Mitre Corporation
NASA Lewis Research Center
Naval Air Test Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Corporation - Aircraft Division
Northrop Defense Systems Division
Operations Analysis
OptiMetrics, Inc.
Phoenix International Unlimited, Inc.
Quest Research Corporation
Rockwell International/NAAO
SAIC
Sanders Associates, Inc.
SofTech, Inc.
Sverdrup Technology, Inc. - TSG
TRW/Defense Systems Group
TRW/Electronic Systems Group
TRW/Military Electronics & Avionics Division
Texas Instruments
Texas Instruments - Radar Division
The Rand Corporation
Tracor Aerospace, Inc.
U.S. Army - CECOM; Center for C3 Systems
U.S. Army - CECOM; Center for EW/RSTA
U.S. Naval Air Facility
USAF ESD/ICZ
Unisys - Systems Management Group
WL/AAWA-1
WL/AAWA-2
Westinghouse Electric Corporation.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: SUWAM - Strategic Unconventional Warfare Assessment Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Training and education (support of seminar war games and exercises).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: SUWAM is designed to provide a special operations element into larger-scale war games.

DESCRIPTION:

Domain: Land.

Span: Individual.

Environment: Weather and terrain.

Force Composition: Individual special operations teams, indigenous personnel.

Scope of Conflict: Special operations team against unalerted target defenses.

Mission Area: Unconventional warfare.

Level of Detail of Processes and Entities: Four highly detailed major groups of interaction: infiltration, link-up, raid, and escape and evasion.

CONSTRUCTION:

Human Participation: Required for initial inputs only.

Time Processing: Closed form.

Treatment of Randomness: Outcomes stochastically based on direct computation of probabilities, with Monte Carlo determination of result.

Sidedness: Two-sided, asymmetric, one side reactive (defense).

LIMITATIONS: Only useful for very small-scale interaction.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Weather, terrain, mission type, infiltration and link-up plan, mission duration, and mission criticality.

OUTPUT: Highly detailed report of mission events. Each major interaction must be successful in order to proceed further in the mission.

HARDWARE AND SOFTWARE:

Computer: IBM-compatible PC.
Storage: N/A.
Peripherals: N/A.
Language: BASIC.
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Five minutes.

CPU time per Cycle: Five seconds.

Data Output Analysis: Descriptive narration of mission events.

Frequency of Use: Several times per year.

Users: N/A.

Comments: SUWAM was originally designed by the National Defense University Wargaming Center and modified by CINCPAC staff Operations Analysts.

TITLE: SUWAM 3.1 - Strategic Unconventional Warfare Assessment Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Training and education.

PROPONENT: Joint Warfare Center, Hurlburt Field, FL 32544-5000.

POINT OF CONTACT: LTC Eric J. Nelson, (904) 884-6928, AV 579-6928.

PURPOSE: SUWAM 3.1 is an updated, MS-DOS version of the National Defense University SUWAM III. It is an unclassified model, which can be used to produce mission results. As an exercise driver, SUWAM 3.1 has also been used to support larger, interactive Joint Training (Command Post) Exercises.

DESCRIPTION:

Domain: Land, sea, and air.

Span: Accommodates any theater.

Environment: Evaluates mission planning inputs and provides the probability of possible results or a set of possible results.

Force Composition: Joint and combined SOF.

Scope of Conflict: Model will assess direct action (raids), hostage rescue, strategic reconnaissance, infiltration (air, sea, and land), resupply, and indigenous force training.

Mission Area: SOF.

Level of Detail of Processes and Entities: Single- and multi-force missions are divided into a series of events. Each event is sequentially simulated to determine the outcome. Results of each event are randomly evaluated in light of opposition threat, target type, team and force size, mission criticality, terrain and environment, weather, and time allocated. Produces generic damage assessments and assessment translations for the mission.

CONSTRUCTION:

Human Participation: Required for decisions and processes. Knowledge of SOF planning required.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo determination of results. Probability tables and translations are based on "professional judgment," but can be edited to reflect statistical values.

Sidedness: One-sided, symmetric, reactive. Will represent either RED or BLUE. Can be operated by one operator.

LIMITATIONS: Requires a manual interface when used with other exercise drivers such as JESS and JTLS.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model has just gone through a major upgrade. Future enhancements include a possible interface with other simulation models.

INPUT: SOF mission planning factors.

OUTPUT: Computer printouts of the probability of possible results or a single set of possible results. Results are coordinated with the primary exercise driver/classified scenario and appropriate message traffic provided to the exercise participants.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on any IBM PC/XT or compatible, any monitor, and adapter.
Storage:	One floppy or one floppy and one hard drive.
Peripherals:	One printer required.
Language:	Borland Turbo Pascal.
Documentation:	A user's manual is available.

SECURITY CLASSIFICATION: Unclassified, but a tailored exercise data base may require classification.

GENERAL DATA:

Data Base: A generic data base is used, and is easily edited to meet specific requirements.

CPU time per Cycle: Very rapid (seconds).

Data Output Analysis: Manual.

Frequency of Use: Varies.

Users: Joint Warfare Center. Has been used to support USCENTCOM. The various Joint and Service schools interested in SOF staff officer training and SOF unit level staff training are potential users.

Comments: SUWAM is part of the Joint Warfare Center's SOF Simulation (SOFSIM) program, as a short-term solution to the need for an SOF simulation, until SOF can be incorporated into larger simulation models such as JESS and JTLS. Long-term use of SUWAM may be limited to unit level staff training, since it can be run on equipment normally found within the unit.

TITLE: SWARM - Strategic Warning and Response Model.

DATE IMPLEMENTED: March 1985 (initiated), December 1988 (Version 3.90).

MODEL TYPE: Analysis.

PROPONENT: National Test Bed/Joint Program Office, Falcon AFB, CO 80912-5000.

POINT OF CONTACT: Peter Knepell (GEODYNAMICS), NTBIC M.S. N8930, Falcon AFB, 80912-5000, (719) 380-2166.

Steven Woodcock (MMC), NTBIC M.S. N8400, Falcon AFB, 80912-5000, (719) 380-2117/3556.

PURPOSE: SWARM is a medium fidelity, end-to-end simulation of SDI systems and threats that evaluates SDI system effectiveness and supports the analysis of dynamic, time-sensitive interactions between multiple strategic layers, the loss of critical assets, and their effects on each side's offensive and defensive force structures. It is fully compatible with the October 1988 Phase I Architecture Document.

DESCRIPTION:

Domain: Air and space with limited naval (submarines); ground possible.

Span: Earth and near-Earth.

Environment: Sunlight and shadow in space or atmosphere; cloud cover; some nuclear effects.

Force Composition: ICBMs, SLBMs, Bombers, ALCMs, ASATs, SBICVs, SBLs, ERIS, HEDI, C2 Nodes, Population Centers, BSTS, SSTS, GSTS, and GBRs.

Scope of Conflict: Primarily nuclear, kinetic, and laser; SDI systems are permitted to interact in a hostile manner.

Mission Area: All SDI missions; some joint SDI-ADI analysis.

Level of Detail of Processes and Entities: SWARM is designed as several separate models linked together via a "framework." Threats are usually aggregated into "tubes," but such aggregation is not necessary. Constellations can be circular or elliptical, with any mix of phasing, inclination, or ascending nodes. Different battle management strategies can be used by each side on a per-phase basis. User-supplied asset "values" are used to prioritize both threat engagement and asset defense. True event physics are modeled to the level of detail supported by each module.

CONSTRUCTION:

Human Participation: Batch model; user required only for initial setup.

Time Processing: Dynamic, time- and event-step. Time-steps to the time the next event on the event queue, not to any uniform clock "tick." A Conflict Manager module prevents invalid or illegal event transactions.

Treatment of Randomness: Stochastic, Monte Carlo. Most kills evaluated during some form of probability of kill.

Sidedness: Two-sided, symmetrical (sometimes referred to as "four-sided").

LIMITATIONS: None intrinsic to the model structure or philosophy. Communications not currently modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Release 4.00 is tentatively scheduled for early spring of 1989. Upgrades to include further enhancements to the sensor model; introduction of fighters and patrolling aircraft; expanded nuclear effects; incorporation of a communications model; links to the NTB CUI environment; and rehosting to NTB Cray-2 and SUN 4/60 workstations.

INPUT: Menuing front-end used for most scenario data entry. Threat tracks provided by external sources or generated internally by SWARM. Preprocessing utilities help user create scenarios, especially in ASAT attack planning.

OUTPUT: STATS postprocessing utility can provide details on weapon usage and wastage by phase, assets destroyed or surviving, system "leakage" by phase, etc. Use of RS/1, a package from BBN Software available on SUN workstations, provides more detailed statistical analysis.

HARDWARE AND SOFTWARE:

Computer:	Currently on Elxsi 6400 running Embos and Cray-2 running Unicos.
Storage:	Memory: 10 MB. Disk Space: 5-15 MB (per scenario).
Peripherals:	One VT-100 (or compatible) terminal, one printer, and one SUN workstation.
Language:	FORTRAN 77 with 55,000 LOC.
Documentation:	User and operations manuals available now. Programmer and technical reference manuals are being developed and should be released with Version 4.00.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: About three man-days for initial scenario generation and data base population.

CPU time per Cycle: Depends on data base size; on the Elxsi, the TSCB-1 scenario runs in nine minutes. Deaggregated threats can take hours.

Data Output Analysis: Some postprocessor analysis; hardcopies available.

Frequency of Use: Used almost constantly. Has supported several NTB/SDIO studies into the Phase One Architecture's survivability and effectiveness.

Users: NTB/JPO, POPMO, SDIO Innovative Architectures Office, Martin Marietta SDI Architecture Study, Martin Marietta SABIR Program, Geodynamics, MITRE.

Comments: SWARM configuration management is controlled via NTB Quality Assurance. It is continually upgraded and enhanced, primarily in response to user needs. It was designed to be a fully two-sided, modular simulation of full strategic triad. Every asset type and object function has a separate modular representation and can be represented at multiple levels of fidelity.

TITLE: SWATEM - Small-Force Weapons and Tactics Evaluation Model.

DATE IMPLEMENTED: 6 August 1991.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Ballistic Research Laboratory (USABRL), Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: Dr. Joseph K. Wald, AV 298-9077.

PURPOSE: SWATEM is a research and evaluation tool that simulates a battle between two small heterogeneous groups of opposing forces. There is a maximum of 10 "game pieces" and 4 different kinds of weapon systems per side. SWATEM was developed to simulate a battle between "pop-up" attack helicopters and air defense systems protecting elements of the maneuver force, but is not limited to this scenario.

DESCRIPTION:

Domain: Land and air (hovering helicopters).

Span: Individual and local (one-on-one and few-on-few).

Environment: Statistical terrain, day and night, and a variety of weather conditions.

Force Composition: Combined arms (principally armor, air defense, and helicopters).

Scope of Conflict: Conventional.

Mission Area: Close combat with helicopters and air defense.

Level of Detail of Processes and Entities: Individual weapon systems are the entities modeled. Model stresses timeline interaction between opposing weapon systems. Detection, unmask and remask, target prioritization, handoff, weapon selection, flyout, intercept, and damage assessment are modeled.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Weapon systems move only while under mask.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Intrinsic weapon system characteristics, interactive weapon system characteristics, and tactics and rules of engagement.

OUTPUT: Killer and victim scoreboards, ammunition expenditure, optional graphics (battlefield "snapshots" of game in progress).

HARDWARE AND SOFTWARE:

Computer: Cray 2/UNIX.

Storage: Approximately 300,00C bytes needed at run time.

Peripherals: 1 (graphics) terminal, 1 line printer.

Language: FORTRAN.

Documentation: U.S. Army Materiel Systems Analysis Activity Technical Report No. 437: The Small-Force Weapons And Tactics Evaluation Model (SWATEM); U.S. Army Ballistic Research Laboratory Technical Report BRL-TR-3060: SWATEM: Input Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: No formal data base. Approximately one day is required to physically assemble a runstream.

CPU time per Cycle: Typically less than 10 seconds per Monte Carlo replication.

Data Output Analysis: No postprocessing required.

Frequency of Use: Used annually for large studies lasting from three to six months.

Users: U.S. Army Ballistic Research Laboratory (USABRL) and U.S. Army Materiel Systems Analysis Activity (USAMSAA).

Comments: Input data comes from a variety of one-on-one "item-level" models.

TITLE: 3DHZD - Three-Dimensional Chemical Hazard Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Atmospheric Science Laboratory,
ATTN: SLCAS-AE-A, White Sands Missile Range, NM 88002-5501.

POINT OF CONTACT: Mr. David Sauter, (505) 678-2078, AV 258-2078.

PURPOSE: 3DHZD is used primarily to determine the dimensions of the vapor hazard to low flying aviators from threat chemical attacks. It is mainly an operation support tool, although it can also be used as a research and evaluation tool.

DESCRIPTION:
Domain: Land and air.

Span: Local.

Environment: Models effects of weather but not terrain.

Force Composition: N/A.

Scope of Conflict: Chemical.

Mission Area: Those involving chemical usage.

Level of Detail of Processes and Entities: Effects on individual aircraft are modeled through the input of aircraft-specific flight characteristics, such as flight speed.

CONSTRUCTION:
Human Participation: Required for decisions (waited for).

Time Processing: Dynamic, time-step.

Treatment of Randomness: Basically deterministic.

Sidedness: N/A.

LIMITATIONS: No complex, terrain-influenced wind.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Include terrain-influenced winds on the transport and diffusion of the chemical vapor as well as additional surface types for liquid agent evaporation rates.

INPUT: Meteorological variables and pertinent parameters describing the chemical agent attack (e.g., number and types of rounds, agent used, location of attack).

OUTPUT: Printout of length, width, and height of the vapor hazard to aviators for up to 10 user-specified times.

HARDWARE AND SOFTWARE:

Computer:	IBM PC or compatible.
Storage:	100 KB on a floppy diskette.
Peripherals:	Printer (optional).
Language:	Turbo Pascal.
Documentation:	Technical report/users guide in review.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Already exists or can be easily obtained.

CPU time per Cycle: Negligible; runs on a PC in minutes.

Data Output Analysis: None; results are easily understood.

Frequency of Use: Variable.

Users: Defense Nuclear Agency, Chemical School, Atmospheric Sciences Laboratory.

Comments: None.

TITLE: TACAP - Tactical Air Command Aircraft Profiler.

DATE IMPLEMENTED: 1974.

MODEL TYPE: Analysis (Operation Support Tool).

PROPONENT: TAC/DOXD.

POINT OF CONTACT: Mel Estes, AFCSA/SAGF, 697-5616 or Ann Brown, 1912th CSGP/DOPO, AV 574-3543.

PURPOSE: The TACAP model is a computer program that provides users with a fast and flexible tool for developing information for refuelable, tactical aircraft. This model simulates the flight of an aircraft cell by computing fuel consumed and time and distance between checkpoints as well as by generating aerial refueling points and corresponding abort routes while giving consideration to climbs, descents, climatological effects, and changes in tanker/receiver ratios en route.

DESCRIPTION:

Domain: Air.

Span: Global.

Environment: Weather and geography.

Force Composition: Can consider selected Air Force, Naval, or Marine aircraft.

Scope of Conflict: Primarily an aircraft deployment model.

Mission Area: Deployment of tactical forces.

Level of Detail of Processes and Entities: Individual aircraft operating in flights during deployment or movement.

CONSTRUCTION:

Human Participation: Required to describe the flight parameters including type of aircraft; number of aircraft; route including departure, en route abort bases, destination base, and alternate airfields; altitudes; weather; and tanker/receiver ratios. Once these input parameters are set, further human participation is not required for the excursion.

Time Processing: Dynamic; time starts at aircraft departure and is reported in hours and minutes throughout the flight as time since departure.

Treatment of Randomness: Deterministic; develops calculations based on algorithms and data.

Sidedness: One-sided.

LIMITATIONS: Limited to exact aircraft and configuration contained in the data base.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Feasibility study in progress to adapt program for use in PCs

INPUT: See Human Participation.

OUTPUT: Computer printouts listing route, times of events, aerial refueling information, and en route abort bases for individual aircraft.

HARDWARE AND SOFTWARE:

Computer: Honeywell 6000 (WWMCCS) - GCOS 8.
Storage: 55K.
Peripherals: Printer.
Language: COBOL/FORTRAN 74.
Documentation: Maintained at 1912th CSGP/DOPO; Langley AFB, VA 23665.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Requires four to six hours to install a new aircraft type into the data base. Requires one to two hours to construct a route structure. Requires less than one hour to devise a JCL for a batch run.

CPU time per Cycle: 0.6 minutes.

Data Output Analysis: Offline.

Frequency of Use: About 500-1000 runs per year.

Users: AFCSA, HQ TAC/DOXD and 2ADG/DON.

Comments: Stand-alone program--output formatted to serve as input to other selected models.

TITLE: TAC BRAWLER.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Analysis (but could be used as a training tool).

PROPONENT: Air Force Center for Studies and Analysis, Regional Forces Division (AFCSA/SAG), The Pentagon, Washington, DC 20330.

POINT OF CONTACT: Maj. Milt Johnson, (202) 697-5677, AV 227-5677.

PURPOSE: TAC BRAWLER is an engagement-level air-to-air combat simulation used primarily for the evaluation of avionics, weapons, and tactics. TAC BRAWLER has also been used as an intelligent target generator in manned simulators.

DESCRIPTION:

Domain: Air-to-air (also simplistic ground-to-air).

Span: Engagement level.

Environment: Smooth earth; day/night effects for IR and visual; user-selected constant radar reflectivity for ground; user selected IR clutter environment (water, urban, rural), cloud layers.

Force Composition: Blue and red forces organized as flights, optionally under control of GCI or AWACS.

Scope of Conflict: Conventional warfare.

Mission Area: All air-to-air missions including Fighter Sweep, Defensive Counter Air, Offensive Counter Air, etc. Bomber missions can be portrayed except for air-to-ground weapon delivery.

Level of Detail of Processes and Entities: Individual aircraft with specific avionics configurations and weapon loadouts; detailed missile flyout; generic models for each avionics device type with differences instantiated through data. Explicit modeling of communications. Aircraft (5-DOF aerodynamics flyout), Missile (4-DOF no roll, detailed seeker representation with explicit tracking and guidance); Radar (level of radar range equation including ground clutter, detailed representation of mechanization); Infrared (Uses LOWTRAN generated tables for transmissivity and tabular data for aircraft IR signatures); sophisticated simulation of pilot decisions utilizing value-driven decision algorithms and an information-oriented architecture.

CONSTRUCTION:

Human Participation: When embedded in manned simulators.

Time Processing: Dynamic, Event-Step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric, both sides reactive.

LIMITATIONS: Flat earth, run time penalty with increasing number of players like n^a, where a= 1.5. Default limits: 24 aircraft, 8 flights - modifiable.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Graphical Display Improvements (display of avionics search patterns during engagement replay; optional view from missile seeker during replay); Front End (X-Window based graphical front end for scenario preparation, graphical display of input data, etc.); added fidelity in C^3, NCTI.

INPUT: Aircraft configurations, initial positions, and initial avionics status; RULES file describing tactics to be utilized; data base of aircraft, avionics, and weapon characteristics.

OUTPUT: Terminal "log" file of important events. User-controlled diagnostic output file. History file for graphical replay of engagements from view of remote observer or from cockpit view. Statistical postprocessor and report generator presenting over 50 MOEs including exchange ratios, loss rates, kill rates, detection ranges by device type, launch ranges, weapon effectiveness MOEs, etc.

HARDWARE AND SOFTWARE:

Computer(OS):	Recommend UNIX machine (MIPS, SUN, Silicon Graphics, etc.) because of availability of a UNIX-based environment for configuration control and concurrent multiple study isolation. Also installed on VAXs.
Storage:	Recommend several hundred MB for source, object, data, and outputs.
Peripherals:	Printer, graphics terminal.
Language:	FORTRAN 77 and several C routines.

Documentation: Management Summary, User, Analyst, and Programmer Manual.

SECURITY CLASSIFICATION: Secret; becomes unclassified upon removal of two small algorithms. Data supplied is UNCLASS, SECRET, and SECRET/NOFORN/WNINTEL.

GENERAL DATA:

Data Base: If using existing weapons, avionics, and airframe data bases, preparation consists of tuning of tactics for engagement and layout of initial flight configurations and positions - generally about a week for engagement with 2 flights on each side but depends upon the complexity of tactics to be employed and number of flights in engagement.

CPU time per Cycle: Depends upon number of aircraft in engagement, engagement duration, and computer speed. For engagement of 4-8 aircraft, 15 minutes of CPU time typical on faster UNIX machines (MIPS, SUN, Silicon Graphics).

Data Output Analysis: As Monte Carlo simulation, requires 20-30 iterations per fixed condition. Statistical postprocessor generates report with numerous MOEs for the set of iterations. Graphical review of all iterations recommended.

Frequency of Use: In continuous use by several users.

Users: USAF (AFCSA/SAG, FTD/SDAEE, ESD, Rome Air Development Center, TAC Joint Studies Group), Navy (NAVAIR, NWC China Lake), Rand, Lockheed, Northrop, Grumman, McDonnell Douglas, Rockwell, General Dynamics, Boeing, General Electric, Loral, LTV, Raytheon, Sanders, Texas Instruments.

Comments: Annual User's Group meeting, usually in October.

TITLE: TACCSF - Theater Air Command and Control Simulation Facility.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis and training.

PROPONENT: Detachment 4, USAF Tactical Air Warfare Center, Kirtland Air Force Base, New Mexico.

POINT OF CONTACT: Det 4 Commander, AV 246-1472, Commercial (505) 846-1472.

PURPOSE: The TACCSF is the world's largest man-in-the-loop air defense simulation. The facility is a national asset, operated by the Air Force, with Army participation, and is available for use by any U.S. or Allied agency. The TACCSF models U.S. air defense weapon systems and related command and control systems at a very high level of fidelity with up to seventy combat-ready air defense crew members operating in a large scale, realistic wartime environment. Under high levels of stress, extensive electronic combat activities, and dense air traffic (up to 2000 airborne tracks), the missile crews, F-15 pilots, and command and control personnel must deal with the same real world communications coordination and track correlation problems they will face in actual combat. The TACCSF has been used to examine proposed new concepts for air defense tactics and doctrine, to assess the survivability of high-value airborne assets, to support training of Army officers enrolled in the Army air defense basic officers course, and to assess the air defense utility of new technologies.

DESCRIPTION:

Domain: Land and air.

Span: Any theater for which DMA terrain data exist. Central Europe, Southwest Asia, and Nellis AFB have been modeled.

Environment: DMA terrain relief data over a 2000 mile square area with weather.

Force Composition: Integrated air defense consisting of all execution level elements; Control and Reporting Center (CRC), Control and Reporting Post (CRP) (modeled as Modular Control Equipment, MCE), E-3, Army Air Defense Brigade, PATRIOT Battalion including 6 fire units, HAWK Battalion with 8 Fire Units, 24 F-15 interceptors, and a special information system (SIS).

Scope of Conflict: Nominally a 2-hour conventional conflict involving all blue air defense elements with a full-scale blue surface-to-air and red/blue air-to-air war. Blue strike aircraft penetrate the red side then return through the blue defenses.

Mission Area: Integrated USA/USAF air defense.

Level of Detail of Processes and Entities: Entities: Individual tactical console positions at all air defense elements (e.g., up to 24 console operators at the CRC). Processes: Surveillance/detection, target tracking, identification, threat assessment, target allocation, engagement, and assessment; extensive ECM and very detailed data link (TADIL-B, -J, ATDL-1, PADIL) models. In many cases, these processes are modeled using the actual system algorithms.

CONSTRUCTION:

Human Participation: Required for decisions and processes. This is a man-in-the-loop simulator with tactically qualified operators at all tactical system consoles operating in the scenarios as they would in their tactical systems.

Time Processing: Real time.

Treatment of Randomness: Deterministic and stochastic/Monte Carlo.

Sidedness: 2-sided, asymmetric. Blue forces are fully reactive, red aircraft react to blue air defense actions. Red air defense is not modeled.

LIMITATIONS: No attrition of blue aircraft by red ground-based air defenses, maximum of 2000 simultaneous tracks.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrading systems to keep them current with actual fielded systems, addition of selected effects-level NCTI models.

INPUT: Fully flexible scenario, systems characteristics specified in data bases and tables.

OUTPUT: Automated files of all events, data link messages, and data collection messages. Facilities exist to compute all defined air defense measures of effectiveness.

HARDWARE AND SOFTWARE:

Computer:	Runs on 21 Concurrent Computer Corp model 3250/80 computers.
Storage:	6 mag tapes, 29 disk drives (average 400MB per drive).
Peripherals:	10 printers, 1 plotter.
Language:	S FORTRAN, UNIX, and C.
Documentation:	Extensive documentation.

SECURITY CLASSIFICATION: Selected submodels are classified Secret. All output data are usually classified Secret. Data bases are generally classified Secret.

GENERAL DATA:

Data Base: Populating large data bases is very time consuming; however, not generally required except to change selected parameters.

CPU time per Cycle: Real time with 1-second motion updates.

Data Output Analysis: Postprocessor assists in reduction of data and calculation of MOEs.

Frequency of Use: 3-4 major (2-3 week duration) tests per year with several short tests interspersed.

Users: HQ Allied Air Forces Central Europe (AAFCE), Air Force Operational Test and Evaluation Center (AFOTEC), U.S. Army Air Defense Artillery School, Joint Air Defense Operations/Joint Engagement Zone (JADO/JEZ) Joint Test Force, U.S. Central Command, Air Force Aeronautical Systems Division (ASD), Air Force Electronic Systems Division (ESD).

Comments: The TACCSF will model Theater Missile Defense using various national resources for tactical ballistic missile tracking and engagement.

TITLE: TACEM - Tactical Aircraft Engagement Model.

DATE IMPLEMENTED: August 1985.

MODEL TYPE: Analysis.

PROPONENT: The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Steve Verna, (703) 848-6373 or John Chalecky, (703) 848-6374.

PURPOSE: TACEM is a many-on-many model designed to evaluate aircraft survivability in a surface-to-air threat environment.

DESCRIPTION:

Domain: Primarily land although ship-based air defenses may be portrayed.

Span: Regional; size of scenario limited only by dimension statements in code.

Environment: Considers terrain masking, day, night, and weather in determining the ability of the air defense systems to detect, prosecute, and intercept the aircraft in a scenario.

Force Composition: Relevant components of BLUE and RED air and air defense forces.

Scope of Conflict: Considers surface-to-air missiles and anti-aircraft artillery.

Mission Area: Any mission area in which aircraft may be engaged by surface-to-air threats.

Level of Detail of Processes and Entities: Model entities are individual aircraft and surface-to-air systems. Air defense processes modeled include aircraft detection, processing, launch, flyout, and interception. Aircraft processes include normal flight, detection of radar lock, detection of missile launch, evasive maneuvering, and release of expendables.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Once line-of-sight exists between an air defense unit and an aircraft, reaction times are drawn from user-input distributions of the time to acquire, time to lock on, and time to compute firing solutions and decide to engage. Aircraft maneuver and release expendables based on Monte Carlo draws against the probability that an aircraft detects a radar lock or launch of a missile. Radar lock may be broken and missiles may be drawn off through an aircraft's use of expendables by a draw against the probability that the expendables are effective. Probability of aircraft kill (pK) is determined through Monte Carlo draw against the pK. Command and control is currently modeled through the use of a probability matrix which specifies the probability that any one air defense unit will engage an aircraft if another unit is already doing so.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Does not explicitly consider air defense command, control, or communications. Does not explicitly consider air defense command, control, or communications.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of a C3 module to handle target cueing and assignment.

INPUT: Requirements include aircraft flight paths, air defense positions and characteristics, and data describing the windows in which SAMs may engage the aircraft in the scenario.

OUTPUT: Statistics on the number of missiles fired by each SAM, number of intercepts, and number of aircraft killed. A computer video of the scenario as it unfolds is available.

HARDWARE AND SOFTWARE:

Computer: DEC VAX (VMS).
Storage: Approximately 300KB.
Peripherals: A graphics terminal for viewing the video is required.
Language: FORTRAN.
Documentation: A user's manual is available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Approximately one man-month.

CPU time per Cycle: Depends on size of scenario.

Data Output Analysis: Raw data, summary statistics, and an exhaustive trace option are available for ease of interpretation.

Frequency of Use: As required.

Users: U.S. Air Force, USMC, OSD, Egyptian Air Force, commercial customers.

Comments: TACEM is a quick-running, easy-to-use model suitable for sensitivity and trade-off analyses.

TITLE: TAC RANGER.

DATE IMPLEMENTED: 1978-1979.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses, The Pentagon, Washington, DC 20330-5420.

POINT OF CONTACT: Maj Mark Olson, (703) 694-4247, AV 694-4247.

PURPOSE: The TAC RANGER program is used in weapons system effectiveness studies to estimate range, loiter time, and payload capabilities for various combat aircraft and various missions.

DESCRIPTION:

Domain: Air.

Span: Individual.

Environment: N/A.

Force Composition: Single element.

Scope of Conflict: All types of aircraft ordnance.

Mission Area: Counter air, interdiction, close air support.

Level of Detail of Processes and Entities: Individual aircraft. Movement (range and radius of operations), loiter time, and changes in aircraft gross weight and drag due to fuel expenditure and weapons delivery.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Dynamic in its use of time, distance, and rate computations to determine aircraft ranges and mission durations.

Treatment of Randomness: Basically deterministic.

Sidedness: One-sided.

LIMITATIONS: The model has not been actively maintained, some modifications to the original model have not been adequately documented, and there is poor user interface.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Port to SUN minicomputer and PC-compatible microcomputer. Improved user interface.

INPUT: Detailed aerodynamic description of aircraft, aircraft weapon loads, and mission profiles.

OUTPUT: Aircraft flight time, weight, fuel, range, altitude, true airspeed, and fuel flow at mission phase points.

HARDWARE AND SOFTWARE:

Computer:	IBM 3081 (MVS).
Storage:	100 bytes of core.
Peripherals:	N/A.
Language:	FORTRAN IV.
Documentation:	Analysts' Manual, Vol. 1, Users' Manual & Program Description, Vol. 2.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Preparation requires one day per aircraft type, two hours per mission and payload.

CPU time per Cycle: 20 seconds per mission.

Data Output Analysis: Minimal time required.

Frequency of Use: Monthly.

Users: AFCSA/SAGF.

Comments: None.

TITLE: TAC REPELLER.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Fraley, DSN 225-5550 or Commercial (703) 695-5550.

PURPOSE: TAC REPELLER investigates the attrition of BLUE aircraft by RED ground-based air defense systems including ADA and radar and IR-guided SAMs. Outputs are used in aircraft weapon system analysis studies.

DESCRIPTION:

Domain: Air and land.

Span: Regional.

Environment: Terrain relief, day/night, weather.

Force Composition: Air component versus air defense component.

Scope of Conflict: Conventional.

Mission Area: Tactical.

Level of Detail of Processes and Entities: Single aircraft versus single air defense site. Process: Attrition, communications, and movement.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Number of players limited.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Aircraft characteristics such as dimensions, RCS, and IR signatures; position data for radars and fire units; individual aircraft flight paths, position, velocity, and orientation; and detection radar parameters, power, frequency, sweep rate, S/N threshold for detection, and antenna gain pattern. Terrain data as seen from viewpoints; threat prioritization parameters; command structure; target selection parameter; ammo stocks and reload times; jammer characteristics such as power, frequency, bandwidth, and gain pattern; countermeasures equipment including jammer and flares carried by individual aircraft; and suppression attacks to be launched by a particular aircraft with an associated probability of kill.

OUTPUT: Computer printouts of missile and target flight paths and detailed analysis, plots, raw data, and statistically analyzed data.

HARDWARE AND SOFTWARE:

Computer: IBM 3081 (MVS), CDC CYBER 176, SUN (UNIX) systems.

Language: FORTRAN 77.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: 1-2 weeks.

CPU time per Cycle: 30 minutes.

Data Output Analysis: N/A.

Frequency of Use: Annually.

Users: AFSAA/SAG.

Comments: None.

TITLE: TAC SABER.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: AD/ENYW, Eglin AFB, FL 32542-5000.

POINT OF CONTACT: Kline Bentley, (904) 882-4457.

PURPOSE: SABER is one of two main models used to support the Nonnuclear Consumables Annual Analysis and Nonnuclear Armament Plan. SABER calculates SSPD for various numbers of aircraft, weapon, and target combinations using several different delivery and weather conditions.

DESCRIPTION:

Domain: Land, air, and limited sea.

Span: Theater.

Environment: Visual/radar and guided weapon deliveries.

Force Composition: BLUE weapons vs. RED targets.

Scope of Conflict: Conventional weapons.

Mission Area: Surface targets, conventional weapons, and tactical maneuvers.

Level of Detail of Processes and Entities: SSPDs for homogeneous targets.

CONSTRUCTION:

Human Participation: Not required beyond preparation of input data.

Time Processing: Static.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: Does not model some smart weapons, mines, or chemical weapons.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Addition of airfield runway targets and pattern calculations for modern dispenser weapons.

INPUT: Launch conditions, delivery accuracy, weapon effectiveness and reliabilities, and target dimensions.

OUTPUT: Printouts of SSPDs for all aircraft, weapon, and target combinations.

HARDWARE AND SOFTWARE:

Computer:	Runs on CDC CYBER.
Storage:	150K bytes.
Peripherals:	Printer.
Language:	FORTRAN.
Documentation:	Limited copies of user manuals available; mathematical methods documented in JMEMS.

SECURITY CLASSIFICATION: Unclassified, but data base is classified.

GENERAL DATA:

Data Base: Large data base requiring periodic revisions.

CPU time per Cycle: Dependent on number of aircraft, weapon, and target combinations being run.

Data Output Analysis: Output is primary input to TAC SELECTOR model that adds attrition data, calculates expected kills over length of war, and sorts results into best weapon list.

Frequency of Use: Used yearly by those listed below (several runs are required for different theaters).

Users: AF/XOXF and AD/XR.

Comments: Managed by AD/ENYW, Eglin AFB, FL.

TITLE: TAC SELECTOR.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis.

PROPONENT: AD/ENYW, Eglin AFB, FL 32442-5000.

POINT OF CONTACT: Kline Bentley (904) 882-4457.

PURPOSE: SELECTOR is one of two main models used to support the Nonnuclear Consumables Annual Analysis and Nonnuclear Armament Plan. SELECTOR applies attrition to SSPDs calculated by the SABER model, computes expected kills over the length of the war, and sorts a best weapon list.

DESCRIPTION:
Domain: Land, air, and limited sea.

Span: Theater.

Environment: Conventional weapons effectiveness against surface targets.

Force Composition: BLUE weapons vs. RED targets.

Scope of Conflict: Conventional weapons only.

Mission Area: To establish war reserve material requirements for conventional weapons.

Level of Detail of Processes and Entities: Individual, conventional weapon effectiveness.

CONSTRUCTION:
Human Participation: Not required except to prepare input parameters.

Time Processing: Static model.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: Does not handle mines and chemical weapons.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None at the present time.

INPUT: SSPDs, aircraft attrition, length of war, and aircraft and weapon cost data.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:
Computer: Runs on CDC CYBER.
Storage: 70K bytes.
Peripherals: Printer.
Language: FORTRAN.
Documentation: Limited copies of user-oriented documentation are available.

SECURITY CLASSIFICATION: Model is unclassified. Input data base and output are classified.

GENERAL DATA:

Data Base: Requires periodic additions and revisions and is very large.

CPU time per Cycle: Dependent on number of aircraft, weapon, and target combinations being processed.

Data Output Analysis: Requires considerable amount of effort to organize into an acceptable weapon mix.

Frequency of Use: Used yearly by those listed below (several runs are required for different theaters).

Users: HQ AF/XOXF and AD/XR.

Comments: This model is closely related to the TAC SABER model.

TITLE: TACSIM - Tactical Simulator.

DATE IMPLEMENTED: 1 September 1980.

MODEL TYPE: Training and education.

PROPONENT: Program Manager - Training Devices, (PM TRADE), Orlando, FL.
TRADOC Proponent: CAC-TNG, Fort Leavenworth, KS 66027-7000.

POINT OF CONTACT: Edward N. Sowell, HQ TEXCOM,
ATTN: ATCT-BA-SIM, Fort Hood, TX 76544; AV 738-9517;
TRADOC POC: MAJ Marion, AV 552-3180, ATZL-CTS-DC.

PURPOSE: To provide an interactive computer-based simulation to support intelligence and electronic warfare (IEW) system development and testing; command post training exercises (CPX); and evaluations of IEW and command, control and communications (C3) functions. It supports decisions, corps and echelons above corps (EAC) systems evaluation, training and the all-source analysis system/enemy situation correlation element (ASAS/ENSCE) program development.

DESCRIPTION:
Domain: Land and air.

Span: Local.

Environment:

Force Composition: OPFOR equipment signatures detectable by sensors.

Scope of Conflict: Conventional war.

Mission Area: Intelligence.

Level of Detail of Processes and Entities:

CONSTRUCTION:
Human Participation: Human participation required for decisions and processes.

Time Processing: Dynamic, event-stepped.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric.

LIMITATIONS: The resolution of the sensor modeling is not sufficient for sensor trade-off studies.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: OPFOR unit observables, their strengths and deployment. OPFOR unit locations and preplanned movement. Operational characteristics of the sensors and tasking. Operational environment such as weather.

OUTPUT: The primary output of TACSIM is intelligence reports in standardized format. These reports are of the quality and quantity expected of the communications, electronic and imagery sensors available to a U.S. commander in wartime. Special reports are also provided to assist simulator operators and exercise controllers.

HARDWARE AND STORAGE:

Computer: VAX 11/785, VAX 8250 OR VAX 8600.

Storage: 16MB internal memory; 4 disk drives with at least 200MB each.

Peripherals: 3 CRTs and one printer.

Language: FORTRAN, SALSIM (FORTRAN version of SIMSCRIPT).

Documentation: TACSIM Users Manual for Liaison Officers and Exercise Controllers; TACSIM Software Description, Vol I-III; TACSIM Operators Manual, Vol I-III; Software User/Operator Manuals (6).

SECURITY CLASSIFICATION: Top Secret - Sensitive Compartmented Information.

GENERAL DATA:

Data Base: 3 months.

CPU time per Cycle: Unknown.

Data Output Analysis: N/A.

Frequency of Use: Supports training of corps and division CPXs.

Users:

Comments: TACSIM is normally run at the sensitive compartmented information (SCI) level of classification which limits its use to SCI facilities.

TITLE: TAC THUNDER.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Analytic Model: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

War Game: National Defense University, Wargaming and Simulation Center, Fort McNair, Washington, DC 20319-6000.

POINT OF CONTACT: Maj. Lum (AFSAA/SAG), DSN 227-5616 or Commercial (703) 697-5616.

PURPOSE: TAC THUNDER is an analysis, research and evaluation tool dealing with weapon systems, force capability and requirements, as well as, training and education.

DESCRIPTION:

Domain: Air and land.

Span: Theater.

Environment: Air and ground combat operations, theater-wide, for multiple day scenarios. Models day and night operations, terrain, and weather. Logistics resupply using a land-based network is modelled.

Force Composition: Joint and combined forces, BLUE and RED.

Scope of Conflict: Conventional.

Mission Area: All conventional missions except amphibious operations and unconventional warfare.

Level of Detail of Processes and Entities: Aircraft are employed in small packages, the sizes of which are determined by planning rules and factors, target characteristics, and mission priorities. Aircraft attrition is Monte Carlo-based using probability of kill data to produce single aircraft kills.

Ground units react to orders provided and posture based on the threat faced. Ground attrition results are deterministic and expressed as specific types of equipment destroyed.

All air and ground operations are logistically constrained. Theater resupply is handled through a surface-based distribution system. The user can define daily arrival rates to simulate intratheater airlift in conjunction with the surface distribution system. Airlift simulation is being reviewed for future incorporation in the model. Critical munitions and equipment resources can be limited in quantity and tracked in the logistics network.

Intelligence operations are modelled based on the perceived attributes of the enemy, which are updated only when intelligence operations are conducted.

CONSTRUCTION:

Human Participation: No user intervention required for decisions. The interruptable game allows the user to make decisions, by exceptions, where desired.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Deterministic land attrition; stochastic air attrition, weather, airbase operations, and intelligence.

Sidedness: Two-sided, reactive. Each side has symmetric capabilities, but the user defines the specific capabilities of each side. Either or both sides can be played automatically by the model.

LIMITATIONS: Limited ground combat representation for envelopment and breakthroughs. Naval operations are not modelled with the exception of aircraft operations from carriers. Limited logistics and C3I.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Modifications are planned for the saturation of enemy air defenses and emissions control. Improvements in air lift and addition of AWACS and JSTARS are also planned.

INPUT: Scenario data base. Player may intervene if desired.

OUTPUT: Status of forces and facilities, results of air and ground operations, and statistics on attrition, mission effectiveness, etc.

HARDWARE AND SOFTWARE:

Computer:	SUN 4 and SPARCSTATION.
Storage:	1-2 MB for each data base; 20MB for program; 20-200 MB for output.
Language:	SIMSCRIPT II.5.
Documentation:	Complete set of published manuals.

SECURITY CLASSIFICATION: Code is unclassified. Most data bases are Secret.

GENERAL DATA:

Data Base: Scenario dependent. A European central region-sized data base may take 4-6 man-months.

CPU time per Cycle: Scenario dependent.

Data Output Analysis: Postprocessing of detailed model transactions provides user-oriented analytical output.

Frequency of Use: Varies by user.

Users: AFSAA/SAG, NDU, ASD, UK MOD, RAF College Cranwell.

Comments: Configuration control operates through the TAC THUNDER User Group. Model enhancements normally made singly or jointly by members of this group.

TITLE: TAC Thunder Intratheater Logistics Module.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Air Forces Center for Studies and Analyses (AFCSA/SAGF), The Pentagon, Washington, DC 20330-5420.

POINT OF CONTACT: Mr. E. Meyer, (703) 694-8157, AV 224-8157.

PURPOSE: The Intratheater Logistics Module analyzes the interaction of intratheater airlift with the air-ground war modeled in the TAC Thunder theater-level model.

DESCRIPTION:
Domain: Land, air, limited naval.

Span: Global.

Environment: The Intratheater Logistics Module models the airlift of supplies and equipment in response to the requirements generated by the ground war during a full-scale TAC Thunder run. The logistics functions can also be exercised in a stand-alone mode based on model-generated or user-input supply requirements.

Force Composition: BLUE/RED theater forces.

Scope of Conflict: Entire gamut of airlift of supplies and equipment.

Mission Area: Airlift.

Level of Detail of Processes and Entities: Individual aircraft for airlift operations.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Event-step model.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided, asymmetric. Capabilities determined by data.

LIMITATIONS: The lowest level Army unit modeled is the division. Unit movements into the theater and horizontal unit movements along the "front" must be entered manually.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Description of cargo aircraft, airbases, unit equipment, and other data required for a TAC Thunder run. Supply requests also needed when module is run in a stand-alone mode.

OUTPUT: Data, echo reports, standard logistics reports, a transaction log, and other reports related to full-scale run.

HARDWARE AND SOFTWARE:

Computer: IBM 3081 (MVS).

Storage: Determined by the amount of data necessary to simulate the scenario and the amount of output required.

Peripherals: Normal system storage devices.

Language: SIMSCRIPT II.5.

Documentation: Standard manual available in AFCSA/SAGF and AFCSA/SAGM.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Not determined.

CPU time per Cycle: 1-2 hours per day.

Data Output Analysis: Depends on level of detail needed.

Frequency of Use: N/A.

Users: AFCSA/SAGM.

Comments: The TAC Thunder Intratheater Logistics Module was created as part of the TAC Thunder model. However, each can be run individually.

TITLE: TAC THUNDER Lift Module.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAS), Pentagon, Rm 1D431, Washington, DC 20330-5420.

POINT OF CONTACT: Mr. E. Meyer, DSN 225-0923 or Commercial (703) 695-0923.

PURPOSE: The Lift Module analyzes the interaction of airlift with the air-ground war modeled in the TAC THUNDER theater-level model. It is primarily an operations support tool.

DESCRIPTION:
Domain: Land, air, limited naval.

Span: Global.

Environment: The Lift Module models the airlift of supplies and equipment in response to the requirements generated by the ground war during a full-scale TAC THUNDER run. The logistics functions can also be exercised in a stand-alone mode based on model generated or user input supply requirements.

Force Composition: BLUE/RED theater forces.

Scope of Conflict: Entire gamut of airlift of supplies and equipment.

Mission Area: Airlift analysis.

Level of Detail of Processes and Entities: Individual aircraft for airlift operations.

CONSTRUCTION:
Human Participation: Not required for runs but necessary for input and output analyses.

Time Processing: Event-step model.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided asymmetric. Capabilities determined by data.

LIMITATIONS: The lowest level Army unit modeled is the division. Unit movements into the theater and horizontal unit movements along the "front" must be entered manually.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Description of cargo aircraft, airbases, unit equipment, and other data required for a TAC THUNDER run. Supply request also needed when module is run in a stand-alone mode.

OUTPUT: Data, echo reports, standard logistics reports, a transaction log, and other reports related to full-scale run.

HARDWARE AND SOFTWARE:

Computer: IBM 3090 MVS/XA.

Storage: Determined by the amount of data necessary to simulate the scenario and the amount of output required.

Peripherals: Normal system storage devices.

Language: SIMSCRIPT II.5.

Documentation: Standard manual available in AFSAA/SAS and AFSAA/SAG.

SECURITY CLASSIFICATION: Model without data is unclassified.

GENERAL DATA:

Data Base: Not determined.

CPU time per Cycle: 1-2 hours per day.

Data Output Analysis: Depends on level of detail needed.

Frequency of Use: N/A.

Users: AFSAA/SAS.

Comments: The TAC THUNDER Lift Module was created as part of the TAC THUNDER model. However, each can be run individually.

TITLE: TACWAR - Tactical Warfare.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Joint Staff, Force Structure, Resource, and Assessment Directorate (J-8), Automation Support Division, Washington, DC 20318-8000.

POINT OF CONTACT: Mr. Arthur W. Paarmann, (703) 697-7824.

PURPOSE: TACWAR is primarily a research and evaluation tool, but can be used as an operation support tool. This includes force mix capabilities at an aggregated level of weapon effectiveness against targets.

DESCRIPTION:

Domain: Air and land.

Span: Theater.

Environment: Uses 12-hour time-steps for conventional analysis. Terrain modeled as contiguous or noncontiguous positions with geographic intervals.

Force Composition: Joint and combined forces.

Scope of Conflict: Conventional, nuclear, and chemical.

Mission Area: Encompasses most combat missions, both air and ground within a theater. Does not explicitly represent SOF, C3I, and CS/CSSD.

Level of Detail of Processes and Entities: Ground entity level varies from company-size subunits (nuclear and chemical) up to more prevalent division-size units. Ground weapons are modeled at an aggregated level by type (i.e., U.S. tank, allied tank). Aircraft are generally modeled by aircraft type (F-16, allied F-16, FLANKER, etc.). The number of aircraft types is user-defined and data dependent. Attrition process for ground based on antipotential potential (APP) process that results in killer-victim scoreboard. Attrition process for air is binomial equation based on single aircraft PDs and PKs resulting in individual aircraft losses and sorties loss rates by mission category.

CONSTRUCTION:

Human Participation: Not required in true simulation mode but desired for decisions in interruptable mode.

Time Processing: Dynamic, time-stepped with user-defined time intervals. Generally used with 12-hour fixed intervals for conventional and 4-hour intervals for nuclear and chemical processes.

Treatment of Randomness: Basically deterministic.

Sidedness: Two-sided, reactive, asymmetric.

LIMITATIONS: Limited C3I. Logistics, envelopment, and breakthroughs not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: An improved supply submodel is in beta version. It models explicitly higher echelon CS/CCS units and their capabilities and values as assets and targets. A munitions tracking processor, which tracks expenditures of individual air and ground munitions has recently been added. A graphics application for reviewing input and output is in development. An INGRES-based data base management system is in progress, but not expected for at least another year.

INPUT: Extensive input variables required to support model execution. These include but are not limited to force structure, theater static characteristics, terrain features, aircraft, aircraft performance values, attrition tables, supply nodes and inventories, and supply consumption rates.

OUTPUT: An exhaustive number of output tables are available; both detailed for debugging and summary for analysis.

HARDWARE AND SOFTWARE:

Computer:	VAX 8600, running VMS.
Storage:	Approximately 1.5 MB.
Peripherals:	Line printer.
Language:	FORTRAN IV/77, "C", Sun View, and NEWS.
Documentation:	User's Guide, Programmer's Maintenance Manual, Analyst's Guides, Action Officer's User's Manual.

SECURITY CLASSIFICATION: Code is unclassified. Data is often classified.

GENERAL DATA:

Data Base: 6 months to create new data base.

CPU time per Cycle: 30 seconds.

Data Output Analysis: Produces hardcopy of raw data.

Frequency of Use: Daily.

Users: CENTCOM, SAC, USF Korea, Army War College, General Dynamics, IDA, U.S. ACDA, SHAPE Technical Center.

Comments: N/A.

TITLE: TAC Weaponeer II.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Air Force Center for Studies and Analyses (AFCSA/SAGF), The Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Lt Col Ron Browning, (703) 697-5615, AV 227-5616.

PURPOSE: TAC Weaponeer II is an analysis tool used to determine the effects of air-to-surface weapons on nonhomogeneous ground target sets. Results show the expected value number of kills for each type target in the set.

DESCRIPTION:

Domain: Land and air.

Span: Local.

Environment: Dynamically models the employment of air-to-surface weapons against ground targets. Weather not specifically modeled.

Force Composition: Aircraft versus one ground element. Single.

Scope of Conflict: Conventional weapons employment.

Mission Area: Ground attack.

Level of Detail of Processes and Entities: Single aircraft. Single piece equipment up to several groups of nonhomogeneous target sets.

CONSTRUCTION:

Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not currently model cluster munitions, precision-guided submunitions, or sensor-fused munitions.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Cluster munitions, precision-guided submunitions, and sensor-fused munitions.

INPUT: Weapon laydown characteristics (aircraft and munition parameters). Target positions and areas of effect.

OUTPUT: Table of expected fractional kills by type equipment.

HARDWARE AND SOFTWARE:

Computer:	SUN 3/4.
Storage:	20 megabytes.
Peripherals:	Mouse and workstation.
Language:	FORTRAN 77 and Template.
Documentation:	Analysts' manual, users' manual, and programmers' manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 30 minutes.

CPU time per Cycle: Depends on computer, model number of munitions, number of targets, and type of targets.

Data Output Analysis: Instantaneous upon run completion.

Frequency of Use: Daily when building expected value tables.

Users: AFCSA/SAGF.

Comments: None.

TITLE: TAFCS - The Army Force Cost System.

DATE IMPLEMENTED: November 1990.

MODEL TYPE: Analysis.

PROPONENT: USACEAC SFFM-CA-PI, 5611 Columbia Pike, Falls Church, VA 22041-5050.

POINT OF CONTACT: Mr. Robert Suchan, (703) 756-0336.

PURPOSE: Deals with costs of TOE Force Structure and Movement.

DESCRIPTION:
Domain: Land.

Span: Theater, regional, and local.

Environment: N/A.

Force Composition: Component (Army).

Scope of Conflict: Peace time.

Mission Area: Procurement and support costs.

Level of Detail of Processes and Entities: Entity: Army unit to SRC level. Process: Acquisition, Activation, Operation, Movement, Deactivation.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Expanded to include deactivation and movement.

INPUT: Weapons System Costs, TOE lists, Cost Relationships.

OUTPUT: Computer printouts.

HARDWARE AND SOFTWARE:
Computer(OS): PC with MSDOS.
Storage: Minimum storage required 40 Megabytes.
Peripherals: Printers.
Language: DBASE Data Files.
Documentation: Under development.

SECURITY CLASSIFICATION: Model without data (unclassified).

GENERAL DATA:

Data Base: None.

CPU time per Cycle: Immediate.

Data Output Analysis: Immediate.

Frequency of Use: Daily.

Users: JCS, DOD, DA Staff, Army MSC's.

Comment: Several Army models feed data into this model: TOE data, AMDF, SB 700-20, AMCOS. Model provides data for Force Builder.

TITLE: TAFSM - Target Acquisition Fire Support Model.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: Simulations Branch, Studies Division, Directorate of Combat Developments, U.S. Army Field Artillery School, Fort Sill, OK 73503-5600.

POINT OF CONTACT: Walter W. Millspaugh, AV 639-6400, Comm (405) 351-640.

PURPOSE: TAFSM is a research and evaluation tool used primarily to analyze the relative differences between competing artillery systems such as target acquisition sensors, automated tactical data systems, ammunition, and ammunition delivery platforms within various arrangements of force structures.

DESCRIPTION:

Domain: Land.

Span: TAFSM is typically played at the U.S. Army division level. Scenarios played include Central Europe and Southwest Asia.

Environment: Normally, TAFSM simulates a 48-hour two-sided conflict. Units move along predetermined paths, but may be slowed by conflict or time of day. Terrain and vegetation are played statistically.

Force Composition: Combined ground forces.

Scope of Conflict: Conventional warfare with emphasis on the artillery conflict. No chemical.

Mission Area: Indirect artillery.

Level of Detail of Processes and Entities: TAFSM features high resolution play of artillery sensors, C3, weapons, and ammunitions. Maneuver attrition may be played with TAFSM's internal ground game or externally with non-artillery attrition derived from the SCORES process. Entities are usually platoon level units or individual weapons or sensors. Sensors acquire and recognize targets which are reported to Fire Direction Centers over explicit communications nets. Fire direction centers allocate and transmit fire missions to subordinate fire units and/or other fire direction centers. Fire units fire assigned missions with conventional, improved-conventional, semiactive laser-guided, autonomous fire-and-forget smart munitions, or smart mines. Casualties are assessed stochastically for each individual artillery round against each individual vehicle in the impact area, not just those vehicles in the unit targeted. The ground attrition model is an analytic, Lanchestrian representation.

CONSTRUCTION:

Human Participation: TAFSM is a closed simulation with no human interaction during execution.

Time Processing: Dynamic, time- and event-stepped model with 1-second resolution.

Treatment of Randomness: TAFSM is stochastic, Monte Carlo.

Sidedness: Two-sided, reactive.

LIMITATIONS: Does not explicitly model Air or Naval fires. Limited electronic warfare. No chemical warfare. Limited number of scenarios are available.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Better electronic warfare, close air support, improved intelligence fusion, air defense, conventional mines, and conversion to C.

INPUT: TAFSM requires as input a scenario with resolution down to platoon level, tables of organization and equipment (TOE), and weapons and ammunition performance data.

OUTPUT: Typically, output consists of printed summary tables of targets acquired, missions fired, rounds fired, and target elements killed. Optional output, given the availability of proper graphics devices, is an interactive graphical display of combat.

HARDWARE AND SOFTWARE:

Computer:	Runs on VAX, SUN 4, or INTEL 386.
Storage:	Model and input data storage totals approximately 10,000 blocks.
Peripherals:	One video terminal for text input/output. If hardcopy is desired, one printer.
Language:	Special purpose language which translates to FORTRAN 77.
Documentation:	Well documented with a User's Manual and a Programmer's manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Several man-months to implement a new scenario. About 2 man-months to build a new weapons data base.

CPU time per Cycle: CPU time For a blue division sized simulation 48 hours of combat is about five hours on a VAX 11/780, 90 min on a SUN 4.

Data Output Analysis: Postprocessor prints summary tables of pertinent statistics. Analysis takes minutes to hours depending on data required.

Frequency of Use: TAFSM is used daily at the proponent activity.

Users: Other users of TAFSM include the FMC corporation, LTV Aerospace, Honeywell, and the Foreign Science and Technology Center.

Comments: The model has been included in a report describing a soft linkage concept to tie together the models in the Army Model Improvement Program.

TITLE: TAGS - Technology for the Automated Generation of Systems.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: Teledyne Brown Engineering, Cummings Research Park, M.S. 202, Huntsville, AL 35807.

POINT OF CONTACT: Gerry Gotvald, (205) 532-1613, Telefax (205) 532-1033.

PURPOSE: TAGS is an operations support tool. The TAGS tools are based on a graphical, executable system design language. From this executable specification of a real-time embedded computer system design, TAGS generates automatic discrete event simulations, automatic Ada code generation, and automatic VHDL generation (in progress).

DESCRIPTION:

Domain: Modeling of system architectures and control flow.

Span: Models real-time systems as they interface to other systems.

Environment: Models computer system data and control flow.

Force Composition: N/A.

Scope of Conflict: Models systems containing real-time embedded computers including BM/C3 functions.

Mission Area: Primarily conventional missions.

Level of Detail of Processes and Entities: The TAGS simulation blueprint allows a mixture of fidelity of subsystem or function components within the same system model patterned after the stepwise refinement human learning process. Analytic models can be combined with functional or probabilistic models.

CONSTRUCTION:

Human Participation: Active user participation may be incorporated in the simulation.

Time Processing: Dynamic I/O time-driven event list.

Treatment of Randomness: Components use deterministic modeling.

Sidedness: One-sided centralized simulation exercised by a single operator at this time. Could be expanded for distributed simulation.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: "C" code generation; rehosting to SUN, VAX Station 2000, IBM PC RT using X windows and UNIX V.3; VHDL generation; and reverse engineering.

INPUT: Environment model or event file.

OUTPUT: Printouts and plots of execution frequencies, mathematical algorithm output, interface traffic, and timelines. POSTSCRIPT printer standard output.

HARDWARE AND SOFTWARE:

Computer: Apollo/Aegis 9.7, SUN/OS 3.5, VAX Station 2000/ULTRIX 2-2, X Windows Version 11, and Ada compiler.

Storage: 24 MB disk space before data base installed; 4 MB minimum workstation.

Peripherals: POSTSCRIPT printer.

Language: "C" and Ada.

Documentation: Extensive documentation with nine manuals.

SECURITY CLASSIFICATION: Unclassified, although data bases may be classified.

GENERAL DATA:

Data Base: Approximately one man-hour per design page in conceptual design and 1/4 man-hour per design page in V&V activities.

CPU time per Cycle: Depends on data base size and workstation memory; large runs may take several hours.

Data Output Analysis: Postprocessor utilities and plotting software packages produce hardcopies for POSTSCRIPT printers.

Frequency of Use: Weekly operation.

Users: NADC, Navy-China Lake, ARMTE, AMCCOM, and NASA.

Comments: Commercially available off-the-shelf computer aided systems and software engineering environment.

TITLE: TALCCM - Tactical Airlift Control Center Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis, Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: Jeffrey T. Hunt, (316) 526-2956.

PURPOSE: TALCCM simulates the operation of a tactical airlift control center. It was specifically designed for analyzing airlifter fleet mixes in a theater. It was also designed to be the nucleus for the development of a decision support system that could be used in actual tactical airlift control centers.

DESCRIPTION:

Domain: Land and air.

Span: Theater of operations.

Environment: Altitude, distances, and temperatures.

Force Composition: Tactical transport aircraft.

Scope of Conflict: Operation of a tactical airlift control center.

Mission Area: Theater airlift.

Level of Detail of Processes and Entities: Entities include individual aircraft, individual trucks to move cargo, and cargo items to be transported either by airplane or truck. The processes modeled include aircraft flight, loading and unloading of cargo, aircraft service, and movement of trucks carrying cargo items.

CONSTRUCTION:

Human Participation: Required to set up data files for execution.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Loading and unloading times are assigned based on an input mean and standard deviation. The random number generator provided the SIMAN software used by the TALCCM uses this mean and standard deviation to generate the time to be used.

Sidedness: One-sided.

LIMITATIONS: While the TALCCM considers the length, width, height, and weight of items to be delivered by aircraft, it models trucks using only the maximum weight for the cargo that may be carried by that truck. Trucks are also assumed to travel at a constant speed between all points. Aircraft fly at a predetermined altitude on all flights, but the TALCCM may be expanded to include flight at multiple altitudes in the future.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Inclusion of threats in the theater and aircraft survivability based on those threats, an ability to alter the scenario interactively during a run or at specific times determined prior to run time, and improved preprocessing functions.

INPUT: Input files are required to provide the following information: origins and destinations of cargo on the theater (this includes things such as latitude, longitude, elevation, runway length, LCN, MCG, etc.); aircraft data (this includes cargo box dimensions, performance data, etc.); aircraft beddown data; job definition data (origin and destination of jobs, list of items to be moved including dimensions of all items, generation time of the job, priority of job, etc.); and ground transportation network data (optional).

OUTPUT: Output includes a scheduling report with all schedulings of deliveries, reschedulings of deliveries to accommodate higher priority jobs, movement of ground vehicles, and airdrop of jobs. Summary reports calculate statistics on aircraft use and job deliveries.

HARDWARE AND SOFTWARE:

Computer: Developed to run in a network of APOLLO DN3000 and DN660 terminals running an AEGIS-DOMAIN/IX (Unix-based) operating system, software release 9.5.

Storage: About 600K for the executable model. Data bases may require considerable additional space.

Peripherals: One printer and one terminal.

Language: APOLLO/DOMAIN FORTRAN, SIMAN (Simulation Analysis Language by Systems Modeling Corp.), APOLLO DOMAIN/IX operating system calls, and TRIRIM data base management system that makes calls to Boeing Military Airplanes' Aircraft Data Base.

Documentation: A testing and verification document and a draft of a preliminary management summary manual are available.

SECURITY CLASSIFICATION: Unclassified, but data could be classified.

GENERAL DATA:

Data Base: Development of data bases could take a considerable amount of time. We have several sets of scenario data modified from the Generalized Air Mobility Model.

CPU time per Cycle: On our hardware, small scenarios may take overnight while large scenarios may run for several days.

Data Output Analysis: Output summary reports provide a considerable amount of summary data. The scheduling report can be used to verify actual schedulings and deliveries made during the run.

Frequency of Use: Several times a year for airlift analyses.

Users: Boeing Military Airplanes, Operations Analysis, and Tanker/Airlift Program Support.

Comments: None.

TITLE: TAM - Theater Analysis Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis (neither a decision maker nor an exercise driver).

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Room BC942, Washington, DC 20318-8000.

POINT OF CONTACT: CDR Craig C. Perry or LTC Steve Starner, (703) 695-2020, AV 225-2020.

PURPOSE: TAM provides the results of military conflict incidental to the conduct of politico-military games. It deals with force capabilities and requirements and provides a foundation for players to assess courses of action and resource planning.

DESCRIPTION:

Domain: Land, sea, and air.

Span: Global, theater, regional, or local.

Environment: Does not model geography but does consider terrain relief, weather, time of day, sea states, and underwater acoustic conditions.

Force Composition: Any mix of forces, BLUE or RED.

Scope of Conflict: All conventional warfare missions.

Mission Area: N/A.

Level of Detail of Processes and Entities: Ground warfare is modeled most effectively at the brigade level and above. Air and naval warfare modeled at an individual level of detail (aircraft and ships). Any number of levels can be represented in the same data base. All attrition results are stochastic and are provided down to the lowest level employed in the data base.

CONSTRUCTION:

Human Participation: Required for operational decisions and processes.

Time Processing: Dynamic, time-step and event-step. Progresses through game moves at a user-specified ratio of exercise time to real time.

Treatment of Randomness: Land attrition is based on a randomly generated entry point to a table of expected values. Air and sea attrition based on direct computation of probability of detection and kill with stochastic determination of results.

Sidedness: Two-sided, symmetric. Can be tested by a operator and operated by any number of players.

LIMITATIONS: Does not model geography, nuclear or chemical warfare, or unconventional warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model is being enhanced continuing basis. Nuclear and chemical warfare are being added, resource assessment capabilities are being improved, and postprocessing reports are being added.

INPUT: Relevant units, weapons, movement, attrition tables, weather, and terrain.

OUTPUT: Printout of movement and attrition as well as detailed data that can be used to document intelligence and logistics.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on any MS DOS-compatible computer. Runs best on 80286 or later generation processor, math coprocessor chip is desirable but not required, and a minimum of 1MB RAM.
Storage:	Requires a minimum of 10 MB.
Peripherals:	1 printer.
Language:	Ada.
Documentation:	User's Manual; Analyst Manual under development.

SECURITY CLASSIFICATION: Unclassified, data bases are classified by individual user.

GENERAL DATA:

Data Base: Population of large data bases can take several man-months to assemble.

CPU time per Cycle: Depends on data base size, player configuration, and processor used. On a typical 80286 processor, a large exercise may require 10-30 minutes run time.

Data Output Analysis: Postprocessor aids in analysis. Model produces hardcopy of raw data, and several preformatted repeats of conflict results.

Frequency of Use: As required.

Users: Politico-Military Simulation and Assessment Division, J-8 to support Joint Staff Politico-Military game requirements, such as CINC's Wargame and NATO CHODS Crisis Response Seminar.

Comments: N/A.

TITLE: TAMARI - Theatre-Level Assessment Model of Air Related Issues.

DATE IMPLEMENTED: Initial AIR only version will be ready by the end of 1991.

MODEL TYPE: Analysis.

PROPONENT: Operation Research Division, SHAPE Technical Centre, Oude Waalgdorperweg 61, P.O. Box 174, 2501 CD, 's-Gravenhage, The Netherlands.

POINT OF CONTACT: J. H. Vink, Tel: (070) 3142338, Fax: (070) 3142111 or P. L. Sparrow, Tel: (070) 3142344, Fax: (070) 3142111.

PURPOSE: TAMARI is intended to model theatre level force on force conflicts in order to obtain battle assessments and to allow comparison of different mixes of forces and/or resources. The model can be used for both force planning and assessment of concepts.

DESCRIPTION:

Domain: Air and land; limited naval operations.

Span: Up to Theatre level.

Environment: Air: Attack routing represented by a connected tree structure to which targets, FEZs and SAM/PAD zones can all be related. Modeling of day/night is included. Implicit representation of C3I in initial version of model. (Land: TBD.)

Force Composition: All important air assets that constitute a force structure.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional air warfare missions. (Land: TBD.)

Level of Detail of Processes and Entities: Air: All important air assets individually and explicitly portrayed. Attrition calculations use data base probabilities to calculate expected kill values to individual entities. Logistics modeled with high resolution. (Land: TBD.)

CONSTRUCTION:

Human Participation: Required to develop force options and scenario drivers.

Time Processing: Dynamic time-stepped model.

Treatment of Randomness: Air attrition calculates expected kills based on input engagement probabilities.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Only models naval targets for interactions associated with the Air/Land battle.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Development Plan:

a. Air only version (implicit C3I).
b. Air only version (explicit C3I + Helicopters).
c. Land/Air version.
d. Wargame version.

INPUT: Fixed data on individual entities are stored in data base (intend to convert to ORACLE). Scenario development requires specification of beddown of forces (including reinforcements with arrival times) and allocator steering variables together with the air attack networks to be utilized. Consistency checks on input include both printouts and graphical representations.

OUTPUT: Output tables can be switched on/off to produce all relevant status tables and results. Data is also sent directly to a history file which can be interrogated using the postprocessor in order to derive desired measures of effectiveness (MOEs).

HARDWARE AND SOFTWARE:

Computer:	Runs on a VAX computer under the VMS operating system.
Storage:	TBD.
Peripherals:	As required (minimum 1 printer + 1 VAX terminal).
Language:	VAX Pascal 4.11.
Documentation:	To be issued.

SECURITY CLASSIFICATION: Model is unclassified. Run classification determined by input/output used/selected.

GENERAL DATA:

Data Base: TBD.

CPU time per Cycle: TBD (But will depend on size of problem).

Data Output Analysis: Postprocessor plus commercial spreadsheet package allow both calculation of MOEs and graphical summaries.

Frequency of Use: TBD.

Users: ORD, SHAPE Technical Centre in support of SHAPE.

Comments: TBD.

TITLE: Tank Wars II - The Sustained Combat Model.

DATE IMPLEMENTED: January 1984.

MODEL TYPE: Analysis.

PROPONENT: Ballistic Research Laboratory (BRL), Aberdeen Proving Ground, MD 21005.

POINT OF CONTACT: Fred Bunn, (301) 278-6648, AV 298-6648.

PURPOSE: Tank Wars is used to evaluate materiel. It was initially designed to evaluate the combat effectiveness of M tanks versus N threat tanks. It has since been extended to evaluate systems firing of TOW, HVM, and STAFF. It has been used extensively to evaluate entire new armored combat vehicle concepts, as well as trade-offs involved in new subsystems.

DESCRIPTION:
Domain: Land.

Span: Local (approximately 10 combatants per side).

Environment: Statistical in-view/out-of-view segment lengths, smoke, and full defilade/hull defilade/fully exposed.

Force Composition: M identical BLUE weapons versus N identical RED weapons.

Scope of Conflict: Conventional at forward area with engagements, RED attack, and BLUE attack.

Mission Area: Direct attack.

Level of Detail of Processes and Entities: Models smoke or terrain via in-view/out-of-view segment lengths using appear, vanish, and hide events. Model acquisition of partially exposed and fully exposed, moving or stationary targets plus system motion via brake, halt, accelerate, and cruise events as well as pop-down and pop-up. Models firing of guns and missiles (including firing of several missiles almost simultaneously from a single platform at several targets) using a fire event. Models direct or top attack, target-switching policies, and hit/miss on 3-dimensional hull and turret via impact and disengage events. Models mobility, firepower, and catastrophic kills via damage, abort (missile), and other events.

CONSTRUCTION:
Human Participation: Not permitted.

Time Processing: Dynamic, event-step (time-step for search).

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, asymmetric, both sides reactive.

LIMITATIONS: Does not use digitized terrain. Cannot handle smoke and terrain simultaneously. Does not yet play bounding overwatch or planned withdrawals to subsequent prepared defensive positions. Does not yet play pop-up, shoot a few, pop-down, and repeat except for systems with missile pods. Does not yet play fractional loss of function. Game continues until one side can no longer fight; it may be more realistic to fight until attacker loses 30% or defender loses 50%. Only one weapon is modeled per vehicle. All weapons on a side are identical.

PLANNED IMPROVEMENTS AND MODIFICATIONS: See limitations above.

INPUT: BRL IUA lethality data, AMSAA accuracy data, miscellaneous data describing system dimensions, search, fire cycle, motion, and weapon use.

OUTPUT: Probability BLUE or RED wins, exchange ratios, ammo consumption, etc. Each event in an engagement can be printed.

HARDWARE AND SOFTWARE:

Computer:	PCs to supercomputers.
Storage:	256 KB.
Peripherals:	Printer.
Language:	FORTRAN 77.
Documentation:	Old user's manual is obsolete; new user's manual is in final draft.

SECURITY CLASSIFICATION: Program is unclassified. Input and output may be classified.

GENERAL DATA:

Data Base: Two weeks for data acquisition, one day for data preparation.

CPU time per Cycle: Clock time for 3 scenarios with 6 opening ranges and 1000 replications per case - 24 hours on PC, 3 hours on mid-sized computer, and 5 minutes on supercomputer (depends on number of users).

Data Output Analysis: One day.

Frequency of Use: 500 runs per year.

Users: BRL, AMSAA, ARDEC, RARDE (UK), Denmark, LTV, General Dynamics, General Defense, LTV Corp, Honeywell, Booz Allen, Rockwell, bootleggers.

Comments: Can be distributed to qualified users on magnetic tape but prefer to use IBM compatible floppy. Distributed with five test cases. Depending on circumstances, POC may be available to assist in implementation. Classified input data must be obtained independently.

TITLE: TAPM - Tactical Aircraft Penetration Model.

DATE IMPLEMENTED: 1983-84.

MODEL TYPE: Analysis.

PROPONENT: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420.

POINT OF CONTACT: Maj. Behymer (AFSAA/SAG), DSN 224-4247, Commercial (703) 614-4247.

PURPOSE: TAPM is used to generate optimum (minimum attrition) ingress and egress flight paths which can be used by attrition models such as ESAMS and TAC REPELLER. The resulting attrition figures can be used in weapons system effectiveness studies.

DESCRIPTION:
Domain: Air and land.

Span: Regional.

Environment: Weather and terrain relief.

Force Composition: Individual aircraft or a small formation of aircraft against enemy air defense components.

Scope of Conflict: Conventional.

Mission Area: Interdiction.

Level of Detail of Processes and Entities: Individual aircraft and individual air defensive units. Processes: Movement of aircraft, attrition.

CONSTRUCTION:
Human Participation: N/A.

Time Processing: Dynamic, no time- or step-events.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: The model has not been actively maintained. No corporate knowledge with the contractor or in the Air Force.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Updated documentation and contracted model support (awaiting funding).

INPUT: For any new missile system, its corresponding ESAMS missile model and associated data base must be included. The user provides scenario data by means of a user-friendly, menu-driven interface. In addition, terrain and weather data bases are required if these effects are to be included. BLUEMAX II aerodynamic and propulsion data bases are also required.

OUTPUT: A file containing flight path points for every 1/2 second of flight. This file is in a form suitable for use by ESAMS and TAC REPELLER. Cumulative Pk is also given. A graphics capability is provided to show the scenario, threat value distributions, terrain contours, and flight path information.

HARDWARE AND SOFTWARE:
Computer: IBM 3081 (MVS), Honeywell (MULTICS).
Language: FORTRAN 77.
Documentation: Documentation is available in AFSAA/SAG.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: N/A.

CPU time per Cycle: N/A.

Data Output Analysis: N/A.

Frequency of Use: Has not been used for several years.

Users: AFSAA/SAG.

Comments: Contains an embedded BLUEMAX II flight path generator.

TITLE: TARA - Target Acquisition and Risk Assessment.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: William T. Cooper, (703) 848-7510 or Robert H. Sharify, (703) 848-6025.

PURPOSE: TARA is used primarily to evaluate the risk to units or force elements, which can assume various postures, in terms of the likelihood of detection and attack (conventional, nuclear, or chemical) by opposing forces. The model also assesses measures for altering that risk.

DESCRIPTION:

Domain: Friendly forces: land. Enemy sensor systems: land and air.

Span: Accommodates up to regional brigade deployment.

Environment: Digitized terrain is in 100m x 100m blocks that include elevation and relative density.

Force Composition: BLUE - brigade scenario postures. RED - sensor system dispersal.

Scope of Conflict: Primarily detection and verification by enemy systems, but effects by conventional, chemical, and nuclear attack after targeting are also analyzed.

Mission Area: All land-based brigade deployment within 400 km of the FLOT.

Level of Detail of Processes and Entities: All detection and targeting results, based on individual company activity location, composition, and lucrativeness factors, can be displayed for each company or for battalions (composed of up to six companies). All units final detection results are broken down to percent of detection by each sensor system within LOS or within range.

CONSTRUCTION:

Human Participation: The model depends on battalion, sensor, and terrain data bases for all input, but the user may specify particular data bases and scenarios before the model is run. User-friendly interactive updates of the data bases are possible before and after a run is completed. Due to the fast run completion time of less than five minutes, no user interruption is required.

Time Processing: Static. Each run simulates a "picture" taken of the force deployment, performing detection analysis at any given instant.

Treatment of Randomness: All detection and verification procedures are deterministic, but there is a Monte Carlo determination of targeting and attack results.

Sidedness: Two-sided, with the RED side (all sensor information) nonreactive.

LIMITATIONS: Does not investigate detection probabilities of air-based vehicles.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model will run in conjunction with the Fulcrum Video Workstation, enabling the user to change and view any information about a force unit displayed on a screen overlaid by various maps. There will be access to each unit on screen via a mouse.

INPUT: Digitized terrain, as provided by the Defense Mapping Agency and BDM. Parameters for BLUE force units include location, activity (for all postures) and lucrativeness factors, environment coverage, company composition, priorities, and type. Parameters for RED sensors include inherent system probability of detection for each zone (1-5), types and amounts, locations, range, delay time, approximate coverage, and weather susceptibility.

OUTPUT: Produces printouts and graphs of detection, verification, targeting, and hit probabilities for each company or battalion, with and without sensor capability, for systems that contributed most to a particular company or battalion's detection, and for the top five most dangerous sensors to a unit type.

HARDWARE AND SOFTWARE:

Computer:	IBM XT, AT, PS/2 or compatible, operating with MS-DOS.
Storage:	2 MB.
Peripherals:	Printers (Fulcrum Video Workstation optional).
Language:	Pascal.
Documentation:	User's manual describing all data bases and routines, along with flowcharts, and interpretation of results.

SECURITY CLASSIFICATION: Unclassified, but data may be classified.

GENERAL DATA:

Data Base: Development in complete BLUE force unit data and RED sensor data in region specified may take a few man-weeks.

CPU time per Cycle: (Based on IBM PS/2 Model 80 system): Initialization of all data in proper format takes 30 seconds. Assigning of all unit and sensor locations needed and checking each for LOS takes 20 minutes. Run time for each scenario with all output ready takes 3 minutes.

Data Output Analysis: Postprocessor develops output into graphics-ready and raw data format.

Frequency of Use: Several times per year by the users below.

Users: DNA, FMC, BDM.

Comments: Model is easily upgraded to specifications desired. The model includes lucrativeness methodology as developed by the U.S. Army Concepts Analysis Agency.

TITLE: TASW - Theater Anti-Submarine Warfare Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Training and education.

PROPONENT: Naval War College; War Gaming Department; Sims Hall; Newport, RI 02841.

POINTS OF CONTACT: CDR. Bo Filanowicz, BDA Branch Chief, AV 948-3276, Comm (401) 841-3276.
Jerry A. Lema, Technical Director, AV 948-4701, Comm (401) 841-4701.

PURPOSE: TASW supports submarine play in seminar war games that incorporate a longer duration timeline (days & weeks versus hours in tactical models). It can also be used for resources planning in a coordinated warfare environment by treating the "many vs. many" scenarios in an aggregated fashion.

DESCRIPTION:

Domain: Sea and undersea.

Span: Theater ASW. Considers orders of battle for two sides engaged in concurrent missions in various geographic areas. Preparator defines, modifies scenario as required. Data bases include surface, subsurface, and air platforms, sensors, weapons, and environmental files for various areas of the world. Files are easily modifiable by a text editor. Flexibility to model emergent platforms, weapons, and sensors also exists.

Environment: Acoustic characteristics for various parts of the world are based on real data, but can be modified to accommodate any area.

Force Composition: Surface, subsurface, and air platforms. Red and blue sides. "Teaming" for coordinated ASW operations is also simulated.

Scope of Conflict: Conventional weapon systems and cruise missiles are modeled. Weapon and sensor system characteristics reside in the data base. Flexibility in weapons selection, based on tactical situation, is a feature of a multiple weapon utility.

Mission Area: Platforms are capable of multiple missions within a scenario, including general area search, area search, cued area search, fixed barrier, moving barrier, counter bastion, flaming datum.

Level of Detail of Processes and Entities: Since the ASW problem is very complex, and the goal is to simulate a total theater asw conflict over a long span of time, the TASW model is necessarily a probablistic aggregated simulation. Preparator defines the theater, units involved, missions and assigns areas of interest. The conflict is composed of moves or time periods that encompass detections, counter-detections, communications, evasion, engagements, and damage assessment. Substantial recording of game details and outcomes are provided, and can be used to modify scenario input.

CONSTRUCTION::

Human Participation: Required for preparation and processes. At the conclusion of each move, assessment and modification can be made to reflect desired changes. Program will produce a log file (background or foreground mode indicating outcomes and processing).

Time Processing: Dynamic, based on event-step.

Treatment of Randomness: Detections, encounters, and outcomes are stochastic, based on Monte Carlo determinations.

Sidedness: Two-sided, symmetric, reactive model prepared and executed under the cognizance of one operator.

LIMITATIONS: Virtually no limitations in modeling the theater ASW problem. Can easily handle numerous entities on both sides, submarines of various types, and emergent platforms.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Provision of target priority values and broad-area sensor.

INPUT: Tableau and menu-driven inputs for theater definition, unit assignments, rules of engagement, and move definition. Text editor can be used to manipulate environment, sensor, weapon, and vessel files.

OUTPUT: Produces the results of encounters. All interim and final processing results can be recorded for each move. Resultant "log" files can also be used to modify and generate new move definitions.

HARDWARE AND SOFTWARE:

Computer:	IBM-PC compatible with at least 640K RAM. Optional math co-processor (recommended).
Storage:	Hard-disk drive (20 MB minimum); 5 1/4 inch or 3 1/2 inch floppy disk drive.
Peripherals:	1 Printer.
Language:	"C".
Operating System:	MS-DOS 3.1 or later.
Documentation:	File construction guide, user construction guide, program performance specification, flowcharts.

SECURITY CLASSIFICATION: Unclassified files exist for testing and demonstration. Typically used in classified game environments.

GENERAL DATA:

Data Base: In existence at Naval War College. Submarine data is classified. Environmental data based on real world data.

CPU time per Cycle: Preparation takes about 30 minutes. Run time is a matter of minutes, but depends on theater definition, numbers of units, move-steps, etc.

Data Output Analysis: Game log files, based on encounters and outcomes are maintained, easily accessible.

Frequency of Use: Several times per year in support of seminar war games, and can be used to reasonably validate and pre-play ASW situation for the enhanced naval warfare gaming system (ENWGS).

Users: War Gaming Department, Naval War College.

TITLE: TAWS - Theatre Air Wargaming System.

MODEL TYPE: Used for analysis at STC, but can also be used as an exercise driver; (e.g., at the Army Staff College, Camberley, UK).

PROPONENT: SHAPE Technical Centre, PO Box 174, 2501 CD Den Haag, The Netherlands.

POINT OF CONTACT: Mr. B. Witherden, IVSN 257-2395, Commercial 070-142395.

PURPOSE: TAWS is a research and evaluation tool which primarily deals with combat development. It can be used to study competing strategies or the effects of new doctrines. It can also be used for capability requirements studies, in particular for resource planning issues. It can also being used as an exercise driver, and is currently being so used at the Army Staff College, Camberley, UK. It can be used stand-alone, or integrated with an IDAHEX land wargame for an integrated land-air wargame.

DESCRIPTION:
Domain: Air (when integrated with IDAHEX, then land and air).

Span: Accommodates any theatre depending on data base. Has been used for each of Central Northern and Southern Regions of Allied Command Europe.

Environment: Lat/long geographical coordinates used but with no terrain features. Day and night operations and four weather types in a grid across the theatre are modeled.

Force Composition: Air forces and air defence assets of ground and naval forces, Blue and Red.

Scope of Conflict: Conventional only.

Mission Area:
- Offensive Counter Air.
- Defensive Counter Air (CAP, GLI).
- Reconnaissance.
- Electronic Warfare.
- Air-to-Air Refueling.
- Offensive Air Support.*
- Interdiction/JPI.*
- Suppression of Enemy Air Defence (SEAD).
- Point/Area SAM air defence.

* Limited unless integrated with IDAHEX.

Level of Detail of Processes and Entities: Data base has a hierarchical structure with 8 levels from level 1 (e.g., HQ AFCENT) through level 8 (e.g., aircraft squadron, SAM battery, EW radar). All aircraft of a certain type are identical (i.e., no tail numbers) but directives can be given for single aircraft missions. SAMs modeled at battery/fire unit level with each missile counted. Logistics counted for each sortie and accounted for at airbases. Aircraft attrition is Monte Carlo based. A many-on-many air-to-air combat is resolved based on Lanchester equations with dynamic dependence on force ratio as each individual aircraft is killed. Intelligence operations and dissemination of information to participating teams is resolved by human interaction and decision from the control team, albeit with several semi-automated routines available to help. Degradations due to Electronic Warfare or degradations in the C3 network are handled in an aggregated fashion at approximately SAM battalion level. Minimum time resolution for events is one minute.

CONSTRUCTION:

Human Participation: Required for decisions in creating input relating to missions to be flown within a typically 6-hour long game cycle. Once the decisions/missions have been input the program executes the cycle without human participation or interruption.

Time Processing: Model is dynamic event-stepped model. Event driven with a time resolution of one minute.

Treatment of Randomness: Model is stochastic. Attrition is based on direct computation of probability of engagement and probability of kill with Monte Carlo determination of result. A few areas (e.g., destruction of area targets) are handled deterministically.

Sidedness: Two-sided, symmetric. Can be tested by a single operator, and typically played by two teams of 5 - 8 players.

LIMITATIONS: No terrain features accounted for. Only two altitudes distinguished for aircraft. Very manpower intensive. In current configuration, mission planning and input for a 6-hour cycle in Central Region takes from 4 - 8 hours.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None planned.

INPUT: For each game cycle, players have to design and input

- OCA Missions.
- OAS Missions.
- Reconnaissance Missions.
- Stand-off Jammer/Escort Jammer Missions.
- AWACS orbits.
- Rebasings, re-rolings, logistics movements.
- SAM movements.
- Combat Air Patrol Missions.
- Fighter engagement zones.

OUTPUT: Printed outputs with detailed documentation of all events. Postprocessor produces customized tables of sorties, losses, mission reports and various listings to help players with planning.

HARDWARE AND SOFTWARE:

Computer:	Basic program in standard FORTRAN and thus portable. When integrated with IDAHEX then a VAX computer with VMS is necessary.
Storage:	TAWS plus satellite programs to build data base plus small unclassified test data base take approx 5 megabytes.
Peripherals:	Minimum requirements: 1 printer, 2 VT 100 terminals.
Language:	FORTRAN V.
Documentation:	STC TM-812, "Theatre Air Wargaming System (TAWS)"; Volume I - Player's Manual; Volume II - Game Designer's Manual; (Model documentation - both unclassified). STC TM-839, "Application of TAWS to the Central Region of ACE" (NS); (Report on a TAWS exercise at STC - NATO Secret).

SECURITY CLASSIFICATION: Model unclassified but data bases often classified.

GENERAL DATA:

Data Base: Large data base (e.g., Central Region) requires 6 man-months to build.

CPU time per Cycle: Dependent on data base size and number of events/missions planned in a cycle. Largest cycle run for Central Region took about 20 min. CPU on VAX 8700 to process 6 hours of combat.

Data Output Analysis: Postprocessor aids in analysis of output. Hardcopies of raw data are produced.

Frequency of Use: Variable.

Users: SHAPE Technical Centre; Army Staff College Camberley, UK; USAFE/DOA; RAND Corporation; Turkish General Staff; Hellenic Army General Staff; Belgian War College, Brussels.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TAXEM - Tactical Exchange Effectiveness Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: Science Applications International Corporation (SAIC), 6725 Odyssey Drive, Huntsville, AL 35806-3301.

POINT OF CONTACT: Ms. Tamara Mooring, (205) 971-6504.

PURPOSE: TAXEM was developed to model the operation, effectiveness and survivability of a CORPS area defense system or "system of systems" against a given attack structure composed of various multiple dynamically allocated attack types. The discrete time advanced event structure provides the framework to evaluate interactions between battle component systems and gain insight into time- and geometry-dependent functions, such as command and communications links, movement, fire, reload, and reconstitution rates.

DESCRIPTION:
Domain: Three-dimensional land and air. Forces/assets deployed in X,Y, Altitude coordinate system.

Span: Systems or sub-theater level.

Environment: Geography modeled by X,Y coordinate system (flat earth). Air/missile threat and air defense performance altitude dependent (trajectory, flight path, approach altitude).

Force Composition: Combined arms.

Scope of Conflict: Conventional, Nuclear, and Chemical/Biological.

Level of Detail of Processes and Entities: System characteristics modeled include battlefield geometry, battle timelines, statistical terrain, fire and reload rates, offense and defense firing strategies, value structures, battle management function, targeting schemes and weapon characteristics. Optimizing battle management function dynamically allocates weapons, or user-supplied weapon allocations (priorities) can be modeled. TAXEM functional structure is modular; modules can be expanded/changed/replaced to model a variety of scenarios.

CONSTRUCTION:
Human Participation: None required.

Time Processing: Discrete event.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided simultaneous (RED and BLUE). Asymmetric; weapon and target deployments unique per side; tactics not mirror-imaged.

LIMITATIONS: Data base preprocessor not available; data base must be edited directly.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Enhancement of sensor/C3 modules. Application of optimizer to various battle functions (offense and defense).

INPUT: System deployments; operating and performance characteristics; target value structure optimizing criteria; battlefield geometry; offense and defense firing strategies.

OUTPUT: Computer printout options display detailed event timeline (history), targeting summary, system effectiveness, and event summary. Apple Macintosh version linked to graphics display of static battlefield and various graphing capabilities.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780 or MicroVAX (VMS); Apple Macintosh (MAC) II.
Language: FORTRAN.
Documentation: Force-on-Force Analysis Guide.

SECURITY CLASSIFICATION: Model without data base is unclassified; data bases are usually classified.

GENERAL DATA:
Data Base: Data base internally documented (labeled) for ease of data entry.

CPU time per Cycle: Basic scenario (for example, a Forward Area Air Defense systems integration scenario with 4 Line-of-Sight Forward-Heavy, 20 defended assets, 1 Ground based sensor and 8 attack aircraft) can execute in approximately 10 seconds on a MAC II.

Data Output Analysis: Simulation results are tabulated. MAC version includes graphics options.

Users: Vought Corporation, USAMICOM (ATM PO), SAIC.

TITLE: TEAM - Threat Engagement Analysis Model.

DATE IMPLEMENTED: Model development is ongoing. Version 1.0 was completed November 1990.

MODEL TYPE: Analysis.

PROPONENT: Air Force Electronic Warfare Center, Studies and Analysis Directorate, Advanced Technologies Division (AFEWC/SAX).

POINT OF CONTACT: Mr. Bob Eddy, (512) 977-2427, AV 969-2427.

PURPOSE: This model is a research, evaluation, and analysis tool used to predict the effectiveness of countermeasures to electro-optic/infrared (EO/IR) missiles.

DESCRIPTION:

Domain: Land and air.

Span: Individual.

Environment: Atmospherics.

Force Composition: One on one.

Scope of Conflict: Conventional.

Mission Area: Self-protection.

Level of Detail of Processes and Entities: Entities in TEAM are the missile, launch aircraft (none if modeling a surface to air missile), target aircraft, missile warning system (MWS), and decoys (flares, chaff, or towed). Missile flyout, aircraft maneuvering, MWS detection of the missile, decoy ejection, and entity signatures are modeled at the functional level. The simulation calculates and plots measures of effectiveness such as lethal area and MWS detection time. 3D animated color graphics are used to view missile flyouts. Scenario setup is accomplished with a mouse-driven hierarchical menu.

CONSTRUCTION:

Human Participation: Not required except for scenario setup. However, human interaction with the graphics output generated by the model is allowed.

Time Processing: Dynamic, time-stepped.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: One missile, one launch aircraft, and one target. One MWS with up to four sensors. One expendable decoy type with up to four ejectors, 100 decoys per ejector. The MWS and decoy models are being expanded to allow multiple types.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model is currently in active development. LOWTRAN 7 will be used for EO/IR propagation and SPIRITS will be used for signature prediction. Terrain effects will be added using DMA Project 2851 data. Algorithms for radar missiles are currently being integrated, and will include clutter, multipath, chaff, and jamming effects. Active, semi-active, and passive radar missiles will be handled.

INPUT: Missile and aircraft aerodynamic and thrust tables. Aircraft signature tables. Missile seeker, autopilot, and guidance parameters. MWS parametrics. MWS sensor locations and orientations. Flare/chaff aerodynamic and signature tables. Decoy ejector locations and orientations. Decoy ejection mode (time or queue-on-detect), ejection velocity, and ejection times.

OUTPUT: Computer printouts, animated 3D graphics display, lethal area and detect time plots.

HARDWARE AND SOFTWARE:

Computer(OS):	Silicon Graphics 4D series with UNIX, or VAX with VMS.
Storage:	5 Mbytes executables; 15 Mbytes source.
Peripherals:	Tektronix 4236 Workstation for VAX version, DEC LN03 laser printer, Tektronix 4693 copier.
Language:	FORTRAN for simulation, C for user interface.
Documentation:	A preliminary users manual is currently available. A complete documentation package, including a maintenance manual, is scheduled for early CY92.

SECURITY CLASSIFICATION: Secret/Noforn.

GENERAL DATA:

Data Base: If all entities currently exist: 5 - 10 minutes to set up a scenario. Creating entities requires a more detailed knowledge of the model and requires approximately one to three man-months depending upon complexity.

CPU time per Cycle: (On a Silicon Graphics 4D25TG). 3 minutes for a single flyout; 1 - 4 hours to create lethal area plot with 36 azimuths (i.e., every 10 degrees) and 10 ranges per azimuth.

Data Output Analysis: Negligible.

Frequency of Use: Continuous.

Users AFEWC/SA. AFECO has been provided a copy of the executable code.

Comments: This model integrates parts of several existing government-owned models and new algorithms using a modular architecture.

TITLE: TECH/MAP - Time Evaluation of Casualty History.

DATE IMPLEMENTED: Initial program design: early 1960s. Improved and enhanced PC and UNIVAC version: 1989.

MODEL TYPE: Analysis.

PROPONENT: CRDEC, Studies & Analysis Office, Aberdeen Proving Ground, MD 21010-5423.

POINT OF CONTACT: Mr. C. Glenvil Whitacre, (301) 671-4241, AV 584-4241.

PURPOSE: The main purpose of this program is to generate a composite grid of output values in terms of concentration, dosage, and deposition values that represent the contamination levels achieved by firing multi-rounds into a battle area.

DESCRIPTION:

Domain: Land: flat terrain with open or wooded conditions.

Span: The target array can vary from platoon to battalion size.

Environment: In-place battlefield units under steady-state MET conditions for transport and diffusion of chemical agent.

Force Composition: Accurately evaluates either BLUE or RED target units.

Scope of Conflict: Chemical warfare.

Mission Area: Chemical battlefield missions.

Level of Detail of Processes and Entities: High resolution assessment methodology. Characterization of chemical cloud patterns and target units can be evaluated in detailed increments over space and in time. Single munition cloud patterns must be represented and input in DOSVEC form. Model then accurately simulates munition delivery process generating the coordinates of the impact points. The addictive contribution of the agent from each functioning munition is assessed at each grid point throughout the targeted and off-targeted areas where agent effects occur. The accumulated agent exposure level at each target grid point is related to an expected casualty value through a dose-response functional relationship for each cell of the sample field. These values are then calculated for the targets.

CONSTRUCTION:

Human Participation: Highly user-interactive during model execution.

Time Processing: Snapshots taken of battlefield as function of time.

Treatment of Randomness: Stochastic, Monte Carlo. Replicates impact generation and calculates expected mean and standard deviation of effects values.

Sidedness: One-sided.

LIMITATIONS: The model needs improved algorithms to access personnel degradation and casualties as well as algorithms to simulate chemical operations taking place within the battle area for evaluation of impact on unit degradation and mission effectiveness.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Extensive redesign and coding improvement are underway to develop a user-friendly PC version. A technique to include consideration of the HOB error is being incorporated, and the technique of predicting the amount of secondary vapor is being redesigned to calculate evaporation from the accumulated composite deposition grid.

INPUT: Program control indicators; location of file for single source cloud DOSVECs; agent toxicity, MET, and munition delivery error parameters; target dimensions and characteristics; aim points; and number of rounds fired.

OUTPUT: A display map of the composite concentration/dosage/deposition patterns as well as expected fractional casualties and area coverage as a function of contour levels for each target.

HARDWARE AND SOFTWARE:

Computer:	Upgraded program will be operational on IBM-compatible PCs and the UNIVAC 1100/80 systems. Current version on PC.
Storage:	Approximately 1600 lines of FORTRAN code now, but fully operational version expected to exceed 2000 lines of code.
Peripherals:	Minimum requirement: one printer.
Language:	ASCII Standard FORTRAN 77.
Documentation:	A technical report documenting the original methodology will be updated and supplemented by a user's guide for this interactive version.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Collection of the munition characteristics, delivery error values as a function of range, and definition of the target arrays are the most time-consuming efforts of preparing the input data bases. Inquiries from the console screen must be answered from the keyboard. Minimum time requirements for input vary from seconds to several minutes depending on user experience and availability of data.

CPU time per Cycle: Typically one to three minutes for a complete run on the PC, but varies and increases as the simulated battlefield scenario increases in complexity.

Data Output Analysis: Results are generally used directly as they are output; postprocessor not needed to analyze the output results.

Frequency of Use: Daily to at least monthly usage anticipated within CRDEC.

Users: Currently CRDEC.

Comments: The main problem with the old "batch" processing of this methodology was the complex input technique used to simulate delivery of chemical munitions. This "new" interactive version will maintain the accuracy capabilities of the delivery process while greatly simplifying the input requirements for the user.

TITLE: TEM - Terrain Effects Model.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWD-1, B-1B SPO, AFOTEC/OAN.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The TEM is a digital computer simulation of a one-on-one terminal engagement of an airborne or ground-based monopulse threat radar, including an air-to-air (AAM) or surface-to-air (SAM) missile system with its homing sensor and a penetrator. The penetrator may be equipped with one or more ECM techniques. The simulation includes a technically complete representation of the theory of terrain reflectivity and provides the capability to evaluate the effects of advanced ECM techniques on the threat tracking radar and on monopulse missile guidance in all phases of the missile flyout profile for both the AAM and SAM systems.

DESCRIPTION: The threat radar is airborne or ground-based and includes angle tracking, and may include velocity. The propagation and reflectivity model includes both skin and jammer returns. Multipath (specular and diffuse forward scatter) can be added to either skin or jammer signals in either the forward or return direction. The multipath model may incorporate DMA digital terrain elevation data (DTED) based on height variations. Separate modes in the simulation are controllable via software logical switches, so that, for instance, the polarization output of a particular horn, the number of horns transmitting and receiving, or the types of reflectivity can be turned on or off to investigate the effects of antenna polarization characteristics, receiver response to particular channel components, or types of reflection from the terrain surface.

The model is both versatile and modular in design, allowing for easy replacement or modification of the various components. The TEM model is broken down into separate components or modules for ease in compiling, changing, and using the program. The modules correspond to the main program, antenna models, penetrator (ECM) and threat models, terrain model, backscatter and forward scatter (multipath) model, reception models, and print and plot outputs. The plot output is typically a separate job-step run from a stored data set generated by a model run.

The threat radar, penetrator ECM gear, penetrator skin, and propagation/reflectivity portions of the model are functionally separated.

The threat radar model includes separate modules for the threat antenna, threat receiver, threat tracker, and threat transmitter.

The penetrator ECM gear model includes separate modules for the jammer antenna(s), jammer receiver/processor, ECM controller, and jammer transmitter antenna. The ECM controller selects one of eight different preprogrammed jammer logics: linear cross-eye, saturated cross-eye, cross-polarization, azimuth terrain bounce, elevation terrain bounce, single axis jammer, towed repeater, or velocity gate pull-off. Other jammers, such as Image Cross-eye and Double Cross, can be simulated by using one of these types with appropriate input data.

The propagation/reflectivity model includes separate modules for the free-space propagation, terrain/sea forward scatter and terrain/sea backscatter (clutter). The terrain/sea forward scatter model deals with threat, jammer, and skin signals; the terrain/sea backscatter model deals with the threat signals.

LIMITATIONS: 1) No search or acquisition processing for target tracking radar; 2) No active missile; 3) Long computer run time.

INPUT:

- Radar, Missile, and ECM RF Parameters.
- Radar, Missile, and ECM Co- and Cross-Polarized Antenna Patterns.
- Target RCS.
- Engagement Geometry Initial Conditions.
- Terrain Parameters.
- Seeker Dynamics Parameters.
- Missile Aerodynamics and Propulsion Parameters.

OUTPUT: TEM output is very detailed for both the RF features (e.g., time histories of seeker off boresight angles, phase and magnitude of sum and difference signals, magnitudes of direct jam signal, skin signal, and multipath signal), the engagement features (e.g., time histories of missile, airborne interceptor, and penetrator x, y, and z positions), and missile and seeker dynamics (e.g., commanded and achieved seeker rates, commanded and achieved missile G's).

HARDWARE AND HARDWARE:
Computer: VAX, SUN, NAS, IBM.
Storage: 6 Mbytes.
Language: FORTRAN.
Documentation: Engineering Manuals; Programmer's Manual; User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 60 minutes; Typical run time: 15 minutes.

Users: Phoenix International Unlimited, Inc.; SAIC; SofTech, Inc.

TITLE: TEMPO - Technical Military Planning Organization.

DATE IMPLEMENTED: December 1986.

MODEL TYPE: Training and Education.

PROPONENT: Air Force Wargaming Center (AFWC), Maxwell AFB, AL 36112-5532.

POINT OF CONTACT: LT COL N. Coyle, AUCADRE/WGO, Maxwell AFB, AL 36112-5532, DSN 493-6618, Commercial (205) 953-6618.

PURPOSE: TEMPO, a seminar exercise driver, addresses force planning and resource allocation under the constraints of time, budget and uncertainty.

DESCRIPTION: TEMPO is a computerized simulation of military force planning and resource management. TEMPO models force planning by analyzing and projecting weapon cost versus utility or "bang-for-the-buck." Students decide on alternate weapon procurement, life cycle costs, long-range goals, force tailoring, and response to adversarial maneuvers, all under the atmosphere of risk and uncertainty.

Domain: Missiles, bombers, fighters, and antiballistic missiles .

Span: Strategic Planning only.

Environment: Strategic.

Force Composition: Air forces only.

Scope of Conflict: Conventional-strategic domain only.

Mission Area: Procurement.

Level of Detail of Processes and Entities: Same as domain.

CONSTRUCTION:
Human Participation: Decisions.

Time Responses: TEMPO is a dynamic, time- and event-stepped model. Time progresses as each side completes a cycle of specified events.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, symmetrical, reactive model.

LIMITATIONS: Teams must manually exchange disks.

PLANNED IMPROVEMENTS AND MODIFICATIONS: A version to work on a local area network is under development.

INPUT: Players decide how to allocate funds for R&D or to acquire, modify, or mothball applicable weapons systems. In addition, they may employ intelligence gathering, counterintelligence and deception.

OUTPUT: TEMPO produces reports describing current weapons, projected weapons, weapons in R&D, maintenance costs, R&D costs, intelligence and counter-intelligence efforts, force mix, and mothballed weapons.

HARDWARE AND SOFTWARE:

Computer (OS): IBM-compatible MS-DOS machine with floppy- and hard-disk drive storage, 640 kilobytes random access memory. TEMPO also requires a printer and monitor (color is optional but preferred).

Storage: Requires 1.0 megabyte for executable and 0.5 megabyte for disk work space.

Peripherals: Monochrome monitor (color optional), printer.

Language: MS-Pascal and MS-Assembler.

Documentation: User and Maintenance Manuals available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: About 8 kilobytes in 13 data files.

CPU time per Cycle: Not applicable.

Data Output Analysis: TEMPO includes a monitor program to recover errors by both system and user. It also allows for hardcopy analysis.

Frequency of Use: Used nine times per year, five times by Squadron Officer School (SOS) and four times by the Professional Military Comptroller School (PMCS).

Users: SOS and PMCS.

Comments: Managed through the review and configuration control board at the AFWC.

TITLE: TerraCAMMs - TERRABASE/Condensed Army Mobility Model System.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Training and education.

PROPONENT: Commander and Director, U.S. Army Engineer Waterways Experiment Station, ATTN: CEWES-GM-L, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

POINT OF CONTACT: Mr. Donald D. Randolph, 601-634-2694.

PURPOSE: Develop tactical decision aids for use by field commanders, terrain analysis, and mobility of battlefield. Operation support tool (decision aid).

DESCRIPTION:

Domain: Mobility of ground vehicles.

Span: Regional, local and individual.

Environment: Considers terrain, relief, and cultural features.

Force Composition: Components.

Scope of Conflict: Predicts mobility of red and blue vehicles.

Mission Area: Ground vehicles.

Level of Detail of Processes and Entities: Single or unit vehicles.

CONSTRUCTION:

Human Participation: Required for unit decision.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Terrain data available.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements include additional TDA to closer define decision aids by different Army Structures, Artillery, Infantry, etc., convert to stochastic process.

INPUT: Vehicle characteristics, unit size, terrain data base.

OUTPUT: Computer maps of speed, terrain factors by class, 3D terrain visualization.

HARDWARE AND SOFTWARE:

Computer: 386 or 486 Unix Operating System.
Storage: 200 MB required.
Peripherals: Printer and monitor.
Language: C and FORTRAN.
Documentation:

SECURITY CLASSIFICATION: None.

GENERAL DATA:

Data Base: Vehicle data 10-20 man-hours per vehicle (most existing vehicles already are prepared). Terrain data preparation of a quad-sheet size area (25x25 km) takes approximately 1 hour to prepare from DMA's Interim Terrain Data Base.

CPU time per Cycle: Seven predictions per second or about 7 minutes for 625 sq km size area.

Data Output Analysis: Soft copy - 20 sec, hardcopy 70 min for 625 sq km size area.

Frequency of Use: Daily.

Users: WES, U.S. Eighth Army, Republic of Korea, U.S. Army Europe, Forces Command, USA Engineer School, 30th Eng Bn (TOPO).

Comments: Contains the same mobility prediction algorithms as the Army Mobility Model (AMM) and the NATO Reference Mobility Model (NRMM).

TITLE: TFDTAM - Tactical Force Deployment Tanker Analysis Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Boeing Military Airplanes, Operations Analysis, Box 7730, M/S K80-33, Wichita, KS 67277-7730.

POINT OF CONTACT: John A. December, Boeing Military Airplanes, Operations Analysis, (316) 526-2956.

PURPOSE: TFDTAM determines the tanker requirements for the deployment of a tactical fighter unit and its supporting cargo aircraft. The model will determine the best tanker types and tanker bases to be used based on user specifications.

DESCRIPTION:

Domain: Land and air.

Span: Global.

Environment: Altitude, distances, and temperatures.

Force Composition: Tactical fighter unit.

Scope of Conflict: Conventional.

Mission Area: Tactical force deployment.

Level of Detail of Processes and Entities: Entities: Individual aircraft. Processes: Single air refueling.

CONSTRUCTION:

Human Participation: Required to set up data files for execution.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model aircraft loading, loading times, aborted air refuelings, or replacement aircraft.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Input files are required to provide the following information: deployment force specification (fighter types, fuel burn data, aircraft parameters); allocation option (type of tankers to potentially use, costs, tanker basing); and data bases (takeoff temperature list, base latitude, longitude, runway length, elevation, routes with turnpoints).

OUTPUT: Output includes a schedule for the takeoff time, flying time, arrival time, fuel burn, and fuel onload for each sortie of the deployment for tankers and receivers; total report showing the number of tankers of each type and the fuel use and cost; and detailed event summary of the times, and distances of each flight event (takeoff, start air refueling, and end air refueling).

HARDWARE AND SOFTWARE:

Computer: Developed to run in a network of APOLLO DN300 and DN660 terminals running an AEGIS-DOMAIN/IX (Unix-based) operating system and software release 9.5.

Storage: About 700K for the executable model. Data bases require additional space.

Peripherals: One printer and one terminal.

Language: APOLLO/DOMAIN Pascal and FORTRAN APOLLO DOMAIN/IX operating system calls, and RTIRIM data base management system that makes calls to Boeing Military Airplanes' Aircraft Data Base.

Documentation: Documentation for management, user/analysts, and programmers is available.

SECURITY CLASSIFICATION: Unclassified, but data could be classified.

GENERAL DATA:

Data Base: Aircraft Data Base is established for many aircraft.

CPU time per Cycle: A typical run for a single fighter squadron would take three hours of computer time. Longer times would be required for determining the amount of cargo to carry on cargo-carrying tankers.

Data Output Analysis: Output reports include summary output and detailed output in chart form.

Frequency of Use: Several times per year for tanker analyses.

Users: Boeing Military Airplanes, Operations Analysis, Tanker/Airlift Program Support.

Comments: N/A.

TITLE: TFMS - Joint STARS Threat Force Model System.

DATE IMPLEMENTED: March 1988.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Vulnerability Assessment Laboratory, SLCVA-CEE, Ft. Monmouth, NJ 07703.

POINT OF CONTACT: Mr. Peter Morel, AV 995-4843 or Mr. Nick Jerschkow, AV 995-4193.

PURPOSE: TFMS was designed to evaluate Joint STARS radar and weapon data link performance in an EW environment, in support of the Joint STARS EW vulnerability analysis efforts currently underway. TFMS utilizes a CORBAN SCORES VI scenario to provide target arrays and operational background environment. TFMS is currently being revised to address ongoing changes being made to the Joint STARS FSD system.

DESCRIPTION:
Domain: Land and air.

Span: Regional (Europe, Fulda Gap) based on SCORES VI.

Environment: Models terrain as well as weather and terrain cultural features per SCORES VI.

Force Composition: BLUE and RED.

Scope of Conflict: Model only addresses EW threat to Joint STARS.

Mission Area: Typical of Joint STARS deployment; can be changed via user input files.

Level of Detail of Processes and Entities: Joint STARS radar is modeled to a functional block level. Threat ECM parameters are entered by the user via input files. Target arrays, ECM deployment, and attrition effects are modeled by SCORES VI. Radar performance is evaluated on a beamprint by beamprint basis against the various target limitations and environmental factors modeled.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time- and event-step.

Treatment of Randomness: Target array attrition based on SCORES VI. Radar and weapon data link modeled deterministically.

Sidedness: One-sided.

LIMITATIONS: SCORES VI limitations apply to target arrays environment factors.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Because of the extensive changes which have been made to the JSTARS design, the model does not accurately reflect the current JSTAR hardware and software configuration. Radar model routines are currently being revised to reflect changes made to the Joint STARS radar. Enhancements to displays and user interface are also in progress.

INPUT: Menu-driven and input files containing parametric data. Input files may be edited by user.

OUTPUT: Process graphic displays and hardcopy of results of simulation runs, e.g., targets detected vs. targets present. Postprocessor routines provide additional data reduction and analysis capability.

HARDWARE AND SOFTWARE:

Computer:	MicroVAX II GPX workstation, VMS 4.5 operating system.
Storage:	9 MB RAM, approx. 145 MB hard disk storage.
Peripherals:	VR-290 workstation (includes display, keyboard, and mouse), one printer, and one plotter are the minimum required.
Language:	VAX FORTRAN, DCL, VAX GKS.
Documentation:	N/A.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Input file preparation can be a lengthy process.

CPU time per Cycle: Typically seconds to minutes depending on input configuration.

Data Output Analysis: Postprocessor provided for data presentation and analysis, hardcopies of raw data.

Frequency of Use: Used approximately several times per month by those listed below.

Users: USA LABCOM-VAL, Ft. Monmouth; BDM Corp., Columbia, MD.

Comments: Managed by USA LABCOM-VAL (SLCVA-CE).

TITLE: Theater Warfare Model.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: HQ USAF/XOXWF.

POINT OF CONTACT: MAJ Greg Phillips, DSN 225-1535, Commercial (703) 695-1535.

PURPOSE: Theater Warfare Model is used primarily to analyze theater level force mixes. It is specifically designed to serve as both an operations support and a force capability tool to assess the effectiveness of different force mixes.

DESCRIPTION:
Domain: Air and land.

Span: Accommodates any theater depending on data base. Several theaters in various levels of completion (Southwest Asia, Korea, Europe, and Soviet Pacific).

Environment: Models day, night, weather, and is distance sensitive.

Force Composition: Blue air forces and red air and ground forces.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional missions except unconventional.

Level of Detail of Processes and Entities: Entities: Lowest entities modeled are individual aircraft types, individual munitions, and army platoons. Processes: Air-to-air attrition uses exchange rates. Air-to-ground attrition based on sortie rates.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Time-stepped.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model terrain.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Electronic warfare module updated. Day/night/weather module updated. Capability to cost module to be added.

INPUT: Scenario development requires aircraft and munitions arrival time in theater, unit characteristics, attrition files, weapons effects files, enemy threat laydown, and enemy target laydown.

OUTPUT: Blue and Red aircraft attrition and Red target destruction by day.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a PC.
Storage:	640K RAM and 20Meg of hard disc space.
Peripherals:	One printer.
Language:	PASCAL and Microsoft C 6.0.
Documentation:	User's manual, functional description, and system specification.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Population of large data bases can take several man-days.

CPU time per Cycle: Under five minutes using a 80386/33MHz.

Data Output Analysis: Produces hardcopy of raw data. Requires a trained analyst to interpret some data.

Frequency of Use: On average several times per month.

Users: HQ USAF/XOXWF.

Comments: Continuously upgraded software.

TITLE: THOR.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: Studies, Analyses and Gaming Section, Plans and Policy Division, CINCPACFLT, Pearl Harbor, HI 96860.

POINT OF CONTACT: Dr. Ray Runyan, (808) 474-8443, AV (315) 474-8443.

PURPOSE: THOR estimates costs (time, aircraft losses, and ordnance expenditures) of a strike campaign to destroy a specified set of targets. Carrier and land-based aircraft, plus TLAM, conduct the strikes. THOR is a tool for high-level planning. Although it simulates aircraft loading and scheduling, it is not intended for carrier- or squadron-level use.

DESCRIPTION:

Domain: Air strikes, primarily on fixed land targets; see "Comments" below.

Span: Various combinations of aircraft, Tomahawk, and targets.

Environment: The user sets values of target-area weather parameters.

Force Composition: Blue aircraft: strike, fighter escort, tanker, SEAD and other support aircraft; Red defenses: SAMs, GCIs, and interceptors; and target set (targets and their aimpoints).

Scope of Conflict: Conventional.

Mission Area: Primarily strike warfare, with associated areas such as air-to-air combat, electronic warfare, and logistic limitations. However, THOR is often integrated with other models; see "Comments" below.

Level of Detail of Processes and Entities: THOR considers processes affecting individual aircraft, individual defensive sites, and individual targets. It treats sortie generation, strike planning, SEAD in considerable detail. THOR considers factors such as weather, ordnance and fuel inventories, repair times (for ordinary breakdowns and battle damage), and tanking constraints.

CONSTRUCTION:

Human Participation: Human participation is not possible after the simulation starts. However, interactive input menus provide for "what if" variations and parametric variations on successive runs. The user approves or modifies default data bases for five general types of variables (see "INPUT" below).

Time Processing: Event-step (for THOR running alone), dynamic for THOR running with ASBAT and/or CLEAR models (see "Comments" below).

Treatment of Randomness: Almost all processes are treated stochastically. While command decision rules and the strike planning emulation are deterministic, they depend on the outcome of prior stochastic events.

Sidedness: Two-sided, asymmetric, but see "Comments" below.

LIMITATIONS: THOR focuses on large "alpha" strikes, rather than smaller, more frequent strikes. It doesn't distinguish between day and night. Effects of enemy defenses en route to target are treated in less detail than defenses in the target area.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Continuing.

INPUT: The user approves or modifies default data bases for five general types of variables: 1) "command decision" variables to reflect various options for the conduct of the campaign; 2) Blue order of battle--for each carrier and base: amount and type of aircraft, fuel and ordnance; 3) selection of targets and aimpoints; 4) Red defensive order of battle--number and capabilities of individual SAM and GCI sites and interceptors, and their location with respect to the targets; 5) various performance factors (probabilities of kill and damage, mean times to repair, fuel capacities, etc.).

OUTPUT: Tabular CRT displays and output files. Graphical outputs available when running under CASES (see "Comments" below).

HARDWARE AND SOFTWARE:

Computer: THOR runs on DEC computers under VMS or on SUN under UNIX. THOR also runs on ENCORE MULTIMAX and DAP parallel processing machines.

Storage: THOR originally ran on a personal computer. Present THOR would require reduction of array sizes (limiting the scope of the strike campaign and/or the number of iterations) on a personal computer.

Peripherals: None required, except when running under CASES.

Documentation: Available from CINCPACFLT.

SECURITY CLASSIFICATION: The model, without data, is unclassified.

GENERAL DATA:

Data Base: CINCPACFLT has a default data base for non-scenario-dependent inputs and keeps a target/weaponeering data base for several thousand targets.

CPU time per Cycle: Depends on the number of aimpoints. A single Monte Carlo iteration for a campaign against a complex of 140 aimpoints runs in about one second on a VAX 8550. Parallel processing speeds THOR by a factor of six.

Data Output Analysis: Output presented as mean, 10th and 90th percentiles.

User and Frequency of Use: Several times a month at CINCPACFLT.

Comments: Although THOR can run alone, it runs under the Real-time Event Joiner (REJ), which can integrate events from THOR with ASBAT, a battle force defense model and CLEAR, a logistics model. ASBAT and CLEAR are included elsewhere in this catalog of models. THOR (and, soon, REJ) can also run under CINCPACFLT's Capabilities Assessment Expert System (CASES).

TITLE: THREAT.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Studies, Analyses, and Gaming Section (Code 64), Plans & Policy Division, CINCPACFLT, Pearl Harbor, HI 96860.

POINT OF CONTACT: Dr. Ray Runyan, (808) 474-8443.

PURPOSE: THREAT is an analysis tool that calculates the AAW threat sector and determines the AAW threat intensity at a specified location, given a laydown of enemy fighter and bomber aircraft. THREAT is intended as an aid to aircraft carrier battle groups in determining transit routes and Combat Air Patrol requirements.

DESCRIPTION:

Domain: Air, land, and sea.

Span: Global.

Environment: Aircraft can be routed to avoid certain geographic areas, otherwise great circle router over unspecified terrain is used to determine reach of aircraft.

Force Composition: RED order of battle consists of numbers and types of RED fighter and bomber aircraft loaded out with numbers and types of AAM and ASM missiles. No BLUE order of battle.

Scope of Conflict: There is no conflict, only the assessment of numbers of AAM and ASM missiles deliverable at a location.

Mission Area: Battle force AAW defense.

Level of Detail of Processes and Entities: Aircraft types are modeled in terms of loadouts, home station location, combat radius. THREAT determines the size sector over which these aircraft can approach and attack the battle force.

CONSTRUCTION:

Human Participation: Required for input only.

Time Processing: Static.

Treatment of Randomness: No Randomness.

Sidedness: One-sided.

Limitations: RED aircraft are assumed to return to the airfield from which they departed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: RED airbase locations, fighter and bomber types and numbers at each airbase, combat radii of each fighter and bomber type, location and detection radius of BLUE battle force.

OUTPUT: Screen display of threat sector and composition of threat sector at a given lat/long, or computer printout of threat contour map over a specified geographic region.

HARDWARE AND SOFTWARE:

Computer:	VAX/VMS system, version 5.0 or above.
Storage:	Executable 52 Kbytes.
Peripherals:	Interactive video terminal.
Language:	VAX FORTRAN.
Documentation:	CINCPACFLT, Studies, Analyses, and Gaming Section, Analysis Memorandum 2-89: THREAT Documentation and User/Programmer Guidelines, 13 April 1989, by Jillian Beuschel, SECRET, UNCLASSIFIED upon removal of Appendix A.

SECURITY CLASSIFICATION: Unclassified without data.

GENERAL DATA:

Data Base: Default data base provided with model. Model prompts user in construction of scenario data base. Simple scenarios within bounds of default data can be constructed in minutes.

CPU time per Cycle: Seconds if a single battle force location is being run, an hour if a threat contains map of the world is requested.

Data Output Analysis: Seconds.

Frequency of Use: Twice per month.

Users: CINCPACFLT, NOSC.

Comments: NOSC has a version of THREAT which has been ported to run on UNIX based parallel processors so that a THREAT contour map of the world is produced in a matter of seconds.

TITLE: Timeline Analysis Model.

DATE IMPLEMENTED: 6 August 1991.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army Ballistic Research Laboratory (USABRL), Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: Dr. Joseph K. Wald, AV 298-9077.

PURPOSE: The engagement sequence, or timeline, of a weapon system consists of a set of functions or processes, some of which must occur sequentially while others may run simultaneously. Each of these processes may be described by a different mathematical or statistical model. In order to be effective, a weapon system may have to complete its entire timeline within a certain time limit. The Timeline Analysis Model, a research and evaluation tool, is a computer program that combines the models of the various timeline components to produce a cumulative total timeline distribution. From this distribution one can determine the probability that the weapon system will be successful in meeting its time limit requirement.

DESCRIPTION:

Domain: Nonspecific.

Span: Single system analysis.

Environment: Nonspecific.

Force Composition: One weapon system.

Scope of Conflict: Exclusively conventional.

Mission Area: Nonspecific.

Level of Detail of Processes and Entities: Individual weapon systems are modeled. Model includes individual weapon system timeline components.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Analyzes one system.

LIMITATIONS: None.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Timeline component distribution statistics.

OUTPUT: Cumulative total timeline distribution curve (graphics and table).

HARDWARE AND SOFTWARE:

Computer: Cray 2/UNIX.
Storage: Approximately 30,000 bytes necessary at run time.
Peripherals: 1 graphics terminal.
Language: FORTRAN.
Documentation: BRL report: The Timeline Analysis Model.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: No formal data base required.

CPU time per Cycle: Typically less than one second per Monte Carlo replication.

Data Output Analysis: No postprocessing required.

Frequency of Use: N/A.

Users: U.S. Army Ballistic Research Laboratory (USABRL), U.S. Army Materiel Systems Analysis Activity (USAMSAA).

TITLE: TIREM - Terrain-Integrated Rough-Earth Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: DoD Electromagnetic Compatibility Analysis Center, North Severn, Annapolis, MD 21402-1187.

POINT OF CONTACT: R. Schneider, (301) 267-2355, DSN 281-2355.

PURPOSE: The TIREM model is a research and evaluation tool that evaluates the terrain profile between two sites and, based on the geometry of the profile, selects a mode of propagation. Appropriate formulations are then applied to compute the basic transmission loss. Modes of propagation include a line-of-sight model, diffraction model, and tropospheric scatter model. The TIREM module is a callable subroutine that provides basic transmission loss for subsequent use in analyzing communications, interference, jamming or intercept performance of systems.

DESCRIPTION:

Domain: Irregular land and/or smooth sea.

Span: Regional.

Environment: Terrain relief.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:

Human Participation: Required to acquire information for data input, a driver to enter input parameters and output routines are required.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: Ducting phenomena or ionospheric modes of propagation are not included. Applicable frequency range: 1 MHz - 20000 MHz.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: Basic terrain profiles are needed along with antenna information and environmental parameters.

OUTPUT: Prints of data and results.

HARDWARE AND SOFTWARE:

Computer:	UNISYS 1100/EXEC 8 and VAX/VMS.
Storage:	N/A.
Peripherals:	Printer and terminal.
Language:	FORTRAN.
Documentation:	Each version separately documented.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Requires arrays of terrain elevation and distance (obtainable from DMA).

CPU time per Cycle: Varies.

Data Output Analysis: Can be interpreted directly.

Frequency of Use: Varies by command.

Users: DoD, ECAC, JEWC, AFEWC.

Comments: Used as basic propagation loss module in PLLM, COM/EW, etc.

TITLE: TIS - Thermal Imaging System Program.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The purpose of the TIS program is to predict the static detection and recognition performance of Electro-Optical (EO) imaging systems which are sensitive in the 305 µm and 8-14 µm wavelength regions of the electromagnetic spectrum.

DESCRIPTION: The program will aid in the evaluation and design of Infrared (IR) systems for missions, encompassing surveillance and target acquisition systems in missile airborne, tank, and air defense applications. This program may be used to evaluate the ability of proposed devices to fulfill field requirements and to recommend future system characteristics and configurations.

The program predictions are for detection and recognition as a function of range for a specified target, background, sensor, atmosphere, countermeasures (CMs), and counter-countermeasures (CCMs). It is a static model since it assumes target acquisition in which the target is in the sensor field-of-view (FOV) and its position is a priori known to the observer. No search of the sensor FOV is involved as in other dynamic models.

INPUT: Some preliminary analysis is needed before a data file can be prepared. This TIS program has several different input modules, each of which consist of one or more records. All input data falls into one of these modules listed below.

- TARGET
- ATMOSPHERE
- OPTICS
- SCANNER
- DETECTOR
- ELECTRONICS
- DISPLAY
- SYSTEM
- STABILIZATION
- EYE
- PROGRAM CARDS
- CM/CCM
- LASER IRRADIANCE

For a more detailed description of the input file see the TIS User's Manual.

OUTPUT: There are two levels of detail that can be requested in the output listing. The standard level consists of five tables as follows:

- Modulation Transfer Function (Individual).
- Modulation Transfer Function (System).
- Minimum Resolvable Temperature Difference.
- Detection Performance Probability.
- Recognition Performance Probability.

All output data refers to the "X" or scan direction. The extended output consists of nine tables as follows:

- Information on "Y" or diagonal direction signal processing.
- Noise-filtering MTF.
- Exact or white noise bandwidth.
- Scan velocity.
- NEΔT.
- MRΔT for target length equal to bar length.
- MDT.
- Temperature and MDT based detection performance; temperature; based recognition performance; optimistic recognition performance.
- Special expressions used in hand calculations.

HARDWARE AND SOFTWARE:
Computer: VAX 11/780.
Storage: 273,408 bytes.
Language: FORTRAN 77.
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source code is Unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 61.5 seconds; Typical run time: 22.5 seconds.

Users:

AFEWC/SAM
ASD/ENSSS
ASD/XRHD
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
E-Systems, Greenville Division
ECAC
General Dynamics
General Dynamics/Convair Division
Georgia Institute of Technology
LTV Missiles and Electronics Group
Link Flight Simulation Corporation
NASA Lewis Research Center
Naval Weapons Center
Naval Weapons Support Center
OptiMetrics, Inc.
SAIC
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
United Technologies
Westinghouse Electric Corporation.

TITLE: TMD/EADSIM - Tactical Missile Defense Command, Control, Communications, and Intelligence Simulation.

DATE IMPLEMENTED: December 15, 1988.

MODEL TYPE: Analysis.

PROPONENT: Joint Tactical Missile Defense Management Office, MICOM, Redstone Arsenal, AL 35898-8010.

POINT OF CONTACT: Mr. Rodney Vaugh, CAS Corporation, Huntsville, AL, (205) 895-8635.

PURPOSE: TMD/EADSIM is designed to provide a comprehensive, comparative assessment of tactical missile defense communications architectures operating dynamically in a postulated physical and electronic warfare threat environment. It is a research and evaluation tool, through which the user can easily change individual system performance characteristics and parameters through a graphic-based menu editing scheme in order to examine comparative system effectiveness.

DESCRIPTION:
Domain: Land, air, and sea surface.

Span: Theater.

Environment: Model incorporates DMA Digitized Terrain Elevation Data and Digital Feature Analysis Data.

Force Composition: Joint and combined forces.

Scope of Conflict: Conventional, nonnuclear RED and BLUE engagements.

Mission Area: C3I operational performance in air and tactical missile defense.

Level of Detail of Processes and Entities: The level of entity is a user-constructed OPFAC, which can be configured as a platform (man, vehicle, aircraft, ship, or stationary site) with systems that are selected to be appended (sensors, weapons, jammers, communication devices, etc.). OPFAC movement is initially programmed in the input scenario. Model execution thereafter alters movement according to communicated commands, engagement reactions, and attrition.

CONSTRUCTION:
Human Participation: Not required during execution; simulation is interruptable for changes and overrides.

Time Processing: Dynamic, time-step position processing and discrete event scheduling.

Treatment of Randomness: Deterministic; values are generated as a function of expected value.

Sidedness: Two-sided, both sides reactive.

LIMITATIONS: The number of elements does effect run time.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Friendly, mutual frequency interference; RED C2; and BLUE airbase operations.

INPUT: BLUE and RED force laydown and communications connectivity, movement and element performance characteristics.

OUTPUT: Dynamic graphic scenario playback and all element activity for desired analysis of measures of performance and measures of effectiveness.

HARDWARE AND SOFTWARE:
- Computer: Silicon Graphics IRIS 4D.
- Storage: 370 MB.
- Peripherals: Seiko color hardcopy unit, cartridge tape unit, and line printer.
- Language: "C".
- Documentation: Model description and users manual.

SECURITY CLASSIFICATION: Unclassified without element performance characteristics; secret with element performance characteristics.

GENERAL DATA:

Data Base: Variable.

CPU time per Cycle: Four times scenario time for complex scenarios.

Data Output Analysis: 30 minutes.

Frequency of Use: Unknown.

Users: MICOM, Redstone Arsenal, AL; OSDC3I, Washington, DC; Strategic Defense Command, Huntsville, AL; TRADOC; U.S. Army Signal Center, Fort Gordon, GA; U.S. Army Air Defense Center, Fort Bliss, TX; U.S. Air Force Europe, Ramstein AFB, GE.

Comments: Setup time is 30 minutes.

TITLE: TMS - Target Management System.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Training and Education.

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof, Germany APO AE 09094.

POINT OF CONTACT: Mr. Tom Doyle (49) 631-536-6507, DSN 489-6507.

PURPOSE: TMS tracks all air-to-ground missions and assesses damage to fixed targets for the WPC Distributed Wargaming System.

DESCRIPTION: TMS is an automated data processing (ADP) system designed for use during computer assisted exercises (CAX). TMS houses a large data base of known targets within the Allied Command Europe (ACE) area of inter st. Based upon the aircraft, weapons load, and ACE Conventional Weapons Guide and the type of target TMS is able to produce an accurate representation of air attacks against fixed targets.

CONSTRUCTION: TMS is designed around "the relational model" and uses INGRES (tm) relational data base management system to access and process data. TMS uses stochastic modeling combined with air mission data to determine the probability of damage. No human participation is required to produce damage assessment, but human intervention is required to review damage assessment.

LIMITATIONS: Currently TMS performs damage assessment against bridges. TMS is designed to handle other target types, but the focus to date has been bridges.

PLANNED IMPROVEMENTS AND MODIFICATIONS: 1) Expand TMS damage assessment capability to include targets like roads, POL storage facilities, airbases, ports, etc.; 2) TMS Graphical presentation layer similar to GIAC; 3) Interface TMS with CBS; and 4) Interface TMS with JTLS.

HARDWARE AND SOFTWARE:

Computer:	DEC VAX 785 on up.
Storage:	50 Megabytes of disk.
Peripherals:	VT 100 compatible CRT.
Language:	VAX VMS FORTRAN with embedded calls to INGRES SQL.

SECURITY CLASSIFICATION: Program source code is unclassified.

GENERAL DATA

Data Base: Correlation of targets to terrain features can require a 2-month effort.

CPU time per Cycle: Damage assessment is near real time.

Data Output Analysis: Interactive and hardcopy can be provided on demand.

Frequency of Use: TMS is used 8010 times per year.

Users: WPC. No limit. Ranges between 5-15.

Comments: Requires INGRES RDBMS to operate.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TNP - Tactical Network Planner.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Analysis.

PROPONENT: TBD.

POINT OF CONTACT: TBD.

PURPOSE: TNP is used primarily to engineer, plan, and manage tactical mobile communications networks, and to rapidly distribute the results of its planning efforts. It is therefore an operational support (decision aid) tool.

DESCRIPTION:
Domain: Land operations.

Span: Accommodates any theater depending on contents of map (geographical) data base.

Environment: Uses terrain relief and feature data.

Force Composition: Combined and joint forces.

Scope of Conflict: Conventional warfare.

Mission Area: Tactical mobile ground based operations with close air support and artillery.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:
Human Participation: Required for process.

Time Processing: Static.

Treatment of Randomness: N/A.

Sidedness: One-sided.

LIMITATIONS: Map size is 1:250,000.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Automatic network laydown and near real time monitoring of VHF spectrum to be added.

INPUT: DMA mapping data is required. Operator inputs subscriber quantities, locations, etc., as well as unit boundaries and assets.

OUTPUT: Computer printouts, map overlays, and electronic transmission to other planning sites.

HARDWARE AND SOFTWARE:

Computer(OS):	Hewlett-Packard type 9000/300 series, ATCCS Common Hardware, UNIX operating system, X-Windows, X-25 packet data interface.
Storage:	16 K RAM plus separate disc storage, 300 and 600 MB.
Peripherals:	Printer and multicolor E-size plotter, color monitor.
Language:	"C".
Documentation:	Deliverable documentation not yet developed.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: DMA data must be reformatted, requiring approximately 8-hour effort.

CPU time per Cycle: System is interactive, longest cycle (network laydown) will require less than two minutes.

Data Output Analysis: Printed outputs and map overlays are ready for use.

Frequency of Use: Varies by operational requirements, but could be many hours per day in intensive training and actual operations.

Users: Signal Corps network planners and managers.

Comments: None.

TITLE: Tomahawk.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education (support of seminar war games).

PROPONENT: Wargaming Department, Naval War College.

POINT OF CONTACT: Micromodels Manager, (401) 841-3276, AV 948-3276.

PURPOSE: Tomahawk models Tomahawk Land Attack Missile and Tomahawk Anti-Ship Cruise Missile strikes against land and sea targets. It is designed to support battle damage assessment in conjunction with larger-scale war games.

DESCRIPTION:
Domain: Land.

Span: Local.

Environment: N/A.

Force Composition: Tomahawk missiles.

Scope of Conflict: Conventional land and sea cruise missiles.

Mission Area: Strike warfare.

Level of Detail of Processes and Entities: User defines type of target, numbers of weapons, and mode of search for each single interaction.

CONSTRUCTION:
Human Participation: Required for initial inputs only.

Time Processing: Closed form.

Treatment of Randomness: Monte Carlo determination of result.

Sidedness: One-sided.

LIMITATIONS: Only useful for specific engagement vice aggregated results.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None anticipated.

INPUT: Type and number of missiles, type of attacking platform, distance from launch point to target, target description, search mode (TASM), targeting information delay time, Tomahawk attrition probabilities, and user-defined probabilities (instead of the program default values).

OUTPUT: Time delay prior to launch, probability of hit and destruction given hit, hits, target post-impact status, and Tomahawk attrition.

HARDWARE AND SOFTWARE:
Computer: IBM-compatible PC with 512K RAM.
Storage: N/A.
Peripherals: N/A.
Language: BASIC.
Documentation: User's manual, source code.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Five minutes (assuming user has previously defined desired hit and lethality probabilities, otherwise the program default values are used).

CPU time per Cycle: Five seconds.

Data Output Analysis: None.

Frequency of Use: Several times per year anticipated.

Users: Wargaming Department, Naval War College.

Comments: Tomahawk is primarily designed to provide battle results for larger-scale war games. Its hits results may be manually input to a battle damage assessment model; e.g., SHIPDAM, for more detailed damage information.

TITLE: Total Force Manpower Tradeoff Model.

DATE IMPLEMENTED: Officer/Civilian: January 1990; Enlisted/Civilian: February 1991; Other Manpower Types: FY93.

MODEL TYPE: Analysis.

PROPONENT: Chief of Naval Operations (OP-12), Navy Annex, Washington, DC 20370.

POINT OF CONTACT: Mr. William Gerade, OP-12G, (703) 695-1975, AV 225-1975.

PURPOSE: The Total Force Manpower Tradeoff Model is an operation support tool (decision aid) that recommends a more cost-effective mix of military and civilian manpower.

DESCRIPTION:

Domain: Sea and shore.

Span: N/A.

Environment: N/A.

Force Composition: Navy.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: Modeled at the skill and grade level. Processes involve sea and shore rotation, estimates of training and career progression needs, and determination of a cost-effective mix of military and civilian manpower within budget and policy constraints.

CONSTRUCTION:

Human Participation: Required for decisions and processes. Model waits for decision.

Time Processing: Static.

Treatment of Randomness: Career progression portion is stochastic, direct computation. All other parts are deterministic, with no randomness.

Sidedness: N/A.

LIMITATIONS: At aggregate skill and grade level.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Unknown; still in development phase.

INPUT: Manpower authorizations and requirements, sea and shore rotation patterns, loss rates, individuals rates, promotion rates, billet cost, equivalent military and civilian grades and skills, and expected endstrength.

OUTPUT: Screen displays and printouts of allocation of military and civilian manpower to resource sponsor, skill, and grade.

HARDWARE AND SOFTWARE:

Computer:	IBM compatible PC running MS-DOS.
Storage:	Estimated at 10 MB.
Peripherals:	Printer.
Language:	Pascal, FOXBASE, and GAMS (linear programming package).
Documentation:	User's and systems manuals will be developed.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Updated in about two weeks.

CPU time per Cycle: Unknown.

Data Output Analysis: Postprocessor will aid in presentation of data.

Frequency of Use: Unknown.

Users: Will be OP-12G, 122, and 123.

Comments: N/A.

TITLE: TOTAL ROUND - Total Round STANDARD MISSILE Simulation.

DATE IMPLEMENTED: Latest upgrade 1988.

MODEL TYPE: Analysis.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.J. Ondrish, (301) 231-2097.

PURPOSE: The purpose of TOTAL ROUND is to evaluate the entire flight profile and the effectiveness of the STANDARD Missile (SM), SM-1 or SM-2, from launch to target intercept.

DESCRIPTION:

Domain: Air, above sea surface.

Span: Local region.

Environment: Air; day and night.

Force Composition: N/A.

Scope of Conflict: Conventional.

Mission Area: AAW.

Level of Detail of Processes and Entities: TOTAL ROUND is a 6-degree-of-freedom simulation of all SM-1 or SM-2 missile activities in an engagement against any type of air target. A family of submodels feeds the main model to provide a total analysis package. TOTAL ROUND simulations are Monte Carlo digital computer programs that generate time histories of all major interacting variables of a total SM weapon system. All major subsystems involved in an engagement are math-modeled, including error statistics, to represent realistic conditions. The overall output of any simulation run represents the digressions from the ideal nominal conditions. Model outputs have been checked against either available flight data or simulations of various portions of round performance as used by other Navy agents, resulting in simulations capable of yielding realistic predictions of total-round performance per threat type. The missile round is simulated as 3-dimensional, 6-degree-of-freedom, rigid body motion over a nonrotating, flat earth for most SM simulations. For SM with extended range, curvature of earth can be considered in simulation. All basic air target types, including cruise missiles, bombers, fighters, and U.S. Navy drones, can be readily represented. The target model has five degrees of freedom, and can handle maneuvers of any kind including slowing down during the turndown and dive phases of anti-ship missiles. The target definition includes bistatic radar cross section and glint.

CONSTRUCTION:

Human Participation: Not required after setup for Monte Carlo r [illegible].

Time Processing: Dynamic, time-step.

Treatment of Randomness: Monte Carlo source error distributions are included.

Sidedness: Two-sided (SM versus target).

LIMITATIONS: None. SM simulations that are currently operational include those for the following variants: SM-1 (MR) Block V, SM-1 (MR) Blocks VI and VI-B, SM-2 (MR) Block I, SM-1 (ER) Block V, SM-2 (ER) Block II, and SM-2 (MR) Blocks I, II, and III (TARTAR and AEGIS). In addition, the SM-2 (MR) Block III AEGIS simulation is being updated to a Block IV simulation.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements are continually being made to model new versions of STANDARD MISSILE as the missile is improved to give increased capabilities.

INPUT: Missile, RF, target parameters.

OUTPUT: Monte Carlo simulation set that, at end of each run, completely describes the particular dynamic missile and target situation that occurs (at time of fuzing and warhead action). For each space point a probability of hit, and probability of placing lethal warhead fragments on target can be obtained.

HARDWARE AND SOFTWARE:
Computer: IBM 3033, VAX 8600.
Storage: Approximately 400K Bytes.
Peripherals: Printer.
Language: FORTRAN and others (CSMP, ACSL).
Documentation: User notes (extensive).

SECURITY CLASSIFICATION: Unclassified, but data base is confidential.

GENERAL DATA:
Data Base: Data base rarely needs changing for a particular block of SM.

CPU time per Cycle: Approximately five minutes for a run set.

Data Analysis Output: No postprocessor used.

Frequency of Use: Daily.

Users: Vitro uses TOTAL ROUND in support of NSWC, JHU/APL, and NAVSEA.

Comments: One or more numerous limiting factors may come into play during the simulated flight of the missile, causing either reduced capability or failure. Such factors include poor search radar data, leading to bad launcher orders; very small, fluctuating target radar return, making missile terminal homing difficult; trajectories requiring large lead angles, leading to seeker head limit failures; or high altitude flights leading to aerodynamic instability.

TITLE: TRAD - Towed Rf Active Decoy Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: Bill High, ITT Avionics, (201) 284-2870.

PURPOSE: This model provides a tool for the analysis of the RF active decoy deployed against a single missile.

DESCRIPTION: The model contains target/missile geometry from launch to closest approach and a mathematically modeled missile (formulated navigation equations as opposed to modeled missile subsystems).

INPUT: Geometry, missile and decoy parameters (including transmitter antenna and frequency).

OUTPUT: Print files and plot files describing missile dynamics and total geometry.

HARDWARE AND SOFTWARE:
Computer: DEC VAX-780.
Storage: 100K Byte; memory requirements: 2M Bytes.
Language: FORTRAN 77 (VAX).
Documentation: Documented sample cases.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Data Base: Typical data preparation is 5 minutes.

CPU time per Cycle: 90 seconds on VAX computer.

Usage: Used for IR&D analysis of towed decoys.

Comments: This program provides plot output which may be displayed on a DEC VAXstation supporting UIS graphics. Two associated plot programs can show missile flyout in real time, and static displays of any plot data generated.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TRANATAK - Transportation Network Attack.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Bruce Lasswell, (804) 734-1050/3449, AV 687-1050/3449.

PURPOSE: TRANATAK is an operations support tool used to furnish information on how transportation requests may be satisfied under constraints of load and unload capability, vehicle availability and capability, terminal and dock availability, network, and enemy attack.

DESCRIPTION:
Domain: Land and air.

Span: TRANATAK handles a wide range of scenarios and transportation networks. The user can select any geographic area where data is available and specify the location of transportation docks.

Environment: Multi-mode transportation network.

Force Composition: Variable.

Scope of Conflict: Variable.

Mission Area: Transportation system.

Level of Detail of Processes and Entities: Vehicles are loaded by weight and cube and travel over the given networks to users. Vehicles may be attacked when halted. All forms of transportation except pipeline may be considered.

CONSTRUCTION.
Human Participation: Not required--scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Either stochastic, Monte Carlo or basically deterministic as required by the user.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Weight and cube of items to be moved, transportation network description, transportation request schedule (based on other model outputs or SCORES scenario), vehicle characteristics and locations, scenario such as location and priority of units, and attack schedule.

OUTPUT: Weight and cube of cargo delivered (also number of items by item), network and vehicle overloads, average and peak workload for each link/terminal, dock and vehicle utilization, vehicle production in terms of weight/distance, and attack results.

HARDWARE AND SOFTWARE:

Computer: Vax 11/780, UNISYS 1100 series.
Storage: Variable.
Peripherals: Printer and tape drive.
Language: FORTRAN IV, GASP IV, and FORTRAN 77.
Documentation: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Varies.

Data Analysis Output: Varies.

Frequency of Use: As needed.

Users: Proponent and U.S. Army Logistics Center.

Comments: TRANATAK was created using the Models of the Army Worldwide Logistics System (MAWLOGS).

TITLE: TRANSACT - Transportation and Supply Activities.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: U.S. Army TRAC-LEE, ATTN: ATRC-LF, Ft. Lee, VA 23801-6140.

POINT OF CONTACT: Mr. Bruce Lasswell, (804) 734-1050/3449, AV 687-1050/3449.

PURPOSE: TRANSACT is an operations support tool used to furnish information on how supply requests may be satisfied under constraints of load and unload capability, vehicle availability and capability, terminal and dock availability, network, and enemy attack.

DESCRIPTION:
Domain: Land and air.

Span: A wide range of scenarios and transportation networks. The user can select any geographic area where data is available and specify the location of supply bases and the movement of units over the area selected.

Environment: A multi-mode transportation network.

Force Composition: Variable.

Scope of Conflict: Variable.

Mission Area: Supply system connected by a transportation network.

Level of Detail of Processes and Entities: TRANSACT represents a multi-echelon supply system connected by a multi-mode transportation network. Modes of transportation can be prioritized when a push system is used for supply. Supply requests can be split among several suppliers. Shipments in the system are consolidated into vehicle loads, and vehicles are allocated and loaded for movement of the shipments. The movement of vehicles throughout the network is simulated over time to permit the analysis of traffic flows and overloads. The model uses the available transportation capability to move all vehicles, and chooses alternate routes if overloads or attacks reduce network capability. Vehicles may be attacked when halted and terminals, supply points, and network may be attacked. Individual shipments are off-loaded from vehicles based on the routing, priority, and vehicle capacity, and are possibly loaded onto other carriers to reach the shipment destination.

Varying demand patterns may be specified to represent changing conditions on the battlefield. The demands from units in different locations drive the model to satisfy the movement requirements over the transportation network. Initial allocation of vehicles can be made to the different units and transportation terminals to specify the capabilities available.

CONSTRUCTION:
Human Participation: Not required--scheduled changes.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Either stochastic, Monte Carlo or basically deterministic as required by the user.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Weight and cube of items to be moved, supply support structure and stockage parameters/policy, transportation network description, supply request schedule, vehicle characteristics and locations, scenario such as location and priority of units, and attack schedule.

OUTPUT: Weight and cube of cargo delivered (also number of items by item), items requested, network and vehicle overloads, average and peak workload for each link/terminal, queue buildups for each link/terminal, supply point workloads and supply status by node/class/item, dock and vehicle utilization, BOH at supply units over time, vehicle production in terms of weight and distance, and attack results.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	Variable, depending on size of supply system and network detail.
Peripherals:	Printer and tape drive.
Language:	FORTRAN 77, FORTRAN IV, and GASP IV.
Documentation:	Users' Guide for LOGATAK II, (DLSIE 42543-MC), Programmers' Guide for LOGATAK II.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Variable.

Data Analysis Output: One to three weeks.

Frequency of Use: As needed.

Users: Proponent and U.S. Army Transportation School, ATTN: ATST-CDC, Ft. Eustis, VA 23604-5394.

Comments: TRANSACT was created using the Models of the Army Worldwide Logistics System (MAWLOGS) modeling system.

TITLE: TRANSMO - Transportation Model.

MODEL TYPE: Analytical.

DATE IMPLEMENTED: 1973.

PROPONENT: U.S. Army Concepts Analysis Agency.

POINT OF CONTACT: Ms. Vera W. Hayes, (DSN) 295-1137 or (301) 295-1137.

PURPOSE: TRANSMO is used primarily to analyze strategic deployment issues taken in the context of the Defense Guidance Illustrative Planning Scenario (DGIPS). It specifically simulates the loading of cargo on intertheater lift vehicles, ultimately resulting in an arrival sequence of cargo in the theater(s) of operation.

DESCRIPTION:
Domain: Sea and air.

Span: Accommodates any theater or theaters depending on data base input.

Environment: Availabilities, loading and unloading time of intertheater lift assets are represented in terms of hundredths of an hour. Port throughput capacities are represented by numbers of lift assets that can be handled at any given time during the simulation.

Force Composition: Movement requirements represent all services, with particular emphasis on Army requirements (data base dependent).

Scope of Conflict: Generally conventional with capability to represent chemical degradation of ports.

Mission Area: Generally represents sea and airlift requirements.

Level of Detail of Processes and Entities: Processes on an hourly basis for aircraft and a daily basis for sealift. Lift assets are represented by their speed and capacity--short tons for airlift and short tons, square feet, and measurements tons for sealift. Movement requirements, which represent a varied level of detail from a division to a UIC or an aggregation of resupply or ammunition requirements, are displayed by their characteristics (bulk, over, outsize cargo for air requirements and short tons, square feet, and measurement tons for sealift requirements). Attrition is based on an expected value; if sea or air assets are in the zone of hazard during the period in which attrition is begin applied, each vessel will be attrited by the expected attrition value in effect. TRANSMO can be viewed as a model with a flexible level of detail ranging from low to high levels of resolution depending upon the input data.

CONSTRUCTION:
Human Participation: None required; relies on scheduled changes.

Time Processing: Dynamic, time- and event-step.

Treatment of Randomness: Sea and air attrition are deterministically determined based on expected value during a time period.

Sidedness:: One-sided.

LIMITATIONS: No specific limitations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT:

- Scenario data include:
  - lift asset availability at POEs.
  - asset capacities.
  - load and unload times.
  - distances between ports.
  - predetermined attrition rates.

- Movement requirements include:
  - availability at the POE.
  - latest arrival date at the POD.
  - unit of measurements expressed in terms of short tons, square feet, and measurement tons.

OUTPUT: Depends on the level of detail and quality of the input. Produces printouts of movement requirements; attrition associated with each requirement, and arrival time at the POD. Many other analyst reports are available for review to determine how the deployment was conducted.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on the UNISYS 1100/84.
Storage:	80,000 blocks (40 MB) for the model only.
Peripherals:	Minimum requirements: one printer, one VT100 terminal, and one 400K block hard disk.
Language:	FORTRAN 77.
Documentation:	User manual with two appendices.

SECURITY CLASSIFICATION: Unclassified, but data bases are generally classified.

GENERAL DATA:

Data Base: Full scenario development and generation of movements requirements require approximately two man-months of effort.

CPU time per Cycle: Scenario dependent, but normally under 30 minutes.

Data Output Analysis: Postprocessor aids in analysis of outputs. Analysis is generally completed within three weeks after the first output is produced.

Frequency of Use: In constant use to support USACAA studies. The model is run more than 100 times per year.

Users: U.S. Army Concepts Analysis Agency.

Comments: Managed by the USACAA to support all strategic deployment studies supporting larger efforts (OMNIBUS, SRA, PFCA, SCAN, and MRFS) changes to the model are made as necessary to support model improvement or when analytical needs dictate.

TITLE: TRANSWAR I - Transportation at War I, (GTA 55-3-5).

DATE IMPLEMENTED: 1984.

MODEL TYPE: Training and education.

PROPONENT: U. S. Army Transportation School.

POINT OF CONTACT: Mr. Benjamin King, AV 927-2113/6482.

PURPOSE: To train Motor Transport Battalion Staff in transportation in a combat environment.

DESCRIPTION:
Domain: Land.

Span: Corps and division.

Environment: Hex-based. Models four types of roads. Models day and night and full range of weather.

Force Composition: U.S. Truck Company with threat ground forces up to platoon level and threat air.

Scope of Conflict: Primarily conventional, but some limited nuclear, chemical, and biological used by threat forces.

Mission Area: All truck battalion missions.

Level of Detail of Processes and Entities: To individual soldier and piece of equipment.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Dynamic.

Treatment of Randomness: Casualties, damage and productivity; Monte Carlo.

Sidedness: One-sided, reactive.

LIMITATIONS: A manual simulation with no computer assistance.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrade to computer assisted version with expanded exercise capabilities FY96.

INPUT: Scenario, to include all combat and logistical data are available at start of exercise.

OUTPUT: Produces move distance on a computer terminal.

HARDWARE AND SOFTWARE: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Time Requirements: Setup and takedown time is 2 hours.

Frequency of Use: Bimonthly.

Users: U.S. Army Truck Battalions.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TRANSWAR II - Transportation at War II, (GTA 55-3-8).

DATE IMPLEMENTED: 1985.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Transportation School.

POINT OF CONTACT: Mr. Benjamin King, Av 927-2113/6482.

PURPOSE: To train Transportation Terminal Battalion Staff in Marine Terminal operations in a combat environment.

DESCRIPTION:

Domain: Land and sea.

Span: Port and Logistics over the shore (LOTS) operations.

Environment: Hex-based. Models four ports and one LOTS site. Models day and night and full range of weather.

Force Composition: U.S. Terminal Service Battalion with threat ground forces up to company level and threat air.

Scope of Conflict: Primarily conventional, but some limited nuclear, chemical and biological used by threat forces.

Mission Area: All terminal service battalion missions.

Level of Detail of Processes and Entities: To individual soldier and piece of equipment.

CONSTRUCTION:

Human Participation: Required.

Time Processing: Dynamic.

Treatment of Randomness: Casualties, damage and productivity: Monte Carlo.

Sidedness: One-sided, reactive.

LIMITATIONS: A manual simulation with no computer assistance.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Planned replacement FY98.

INPUT: Scenario, to include all combat and logistical data are available at start of exercise.

OUTPUT: None.

HARDWARE AND SOFTWARE: N/A.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Setup and takedown time is 2 hours.

Frequency of Use: Semi-annually.

Users: U.S. Army Terminal Service Battalions.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TRANSWAR III - Transportation at War III, (GTA 55-3-9).

DATE IMPLEMENTED: 1986.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Transportation School.

POINT OF CONTACT: Mr. Benjamin King, AV 927-2113/6482.

PURPOSE: To train Transportation Staff personnel in Movement Control operations in a combat theater. It has also been used as an exercise driver.

DESCRIPTION:
Domain: Land, sea and air.

Span: Theater.

Environment: Hex-based. Models four types of roads, two types of railroads, airfields, ports and inland waterways. Models day and night and full range of weather.

Force Composition: U.S. Forces are joint and combined with full range of logistical support. Threat forces are combat only.

Scope of Conflict: Primarily conventional, but some limited nuclear, chemical, and biological used by threat forces.

Mission Area: All transportation missions down to, but not including, division level.

Level of Detail of Processes and Entities: Transportation units to company level; combat units to brigade level. Others depend on mission.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Dynamic.

Treatment of Randomness: Casualties, damage and productivity: Monte Carlo.

Sidedness: Two-sided, asymmetric, reactive.

LIMITATIONS: Commodities limited to 23 types of Class V, 3 types of Class III and 5 types of Class VII, by cube and weight. Classes I, II, IV, VI, VII, IX, and X are classified by average cube and weight.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrade of automation FY95.

INPUT: Scenario, to include all combat and logistical data are available at start of exercise. Required input for losses, expenditures, arrivals, and deliveries.

OUTPUT: Produces printouts of receipts and shipments to storage facilities and combat units from division to theater. Also gives combat status of each division on a daily basis.

HARDWARE AND SOFTWARE:
Computer: IBM compatible PC with 20MB hard drive. Software, LOTUS 1,2,3 Version 2 or higher and BASIC.
Peripherals: 1 wide carriage printer.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Time Requirements: Setup and takedown time is 4 hours. Time to load software is minimal.

Frequency of Use: Two to three times per year.

Users: 300th Transportation Group USAR; 184th Transportation Group USNG; U.S. Army Transportation School; 23rd Transportation Battalion (Movement Control); and 1st Transportation Liaison Flight USAFR.

TITLE: TRANSWAR IV - Transportation at War IV, (GTA 55-3-10).

DATE IMPLEMENTED: 1988.

MODEL TYPE: Training and education.

PROPONENT: U.S. Army Transportation School

POINT OF CONTACT: Mr. Benjamin King, AV 927-2113/6482

PURPOSE: To train truck company officers and enlisted personnel in Truck Company operations.

DESCRIPTION:
Domain: Land.

Span: Theater to division.

Environment: Hex-based. Models four types of roads. Models day and night and full range of weather.

Force Composition: U.S. Truck Company with threat ground forces up to platoon level and threat air.

Scope of Conflict: Primarily conventional, but some limited nuclear, chemical, and biological used by threat forces.

Mission Area: All truck company missions.

Level of Detail of Processes and Entities: To individual soldier and piece of equipment.

CONSTRUCTION:
Human Participation: Required.

Time Processing: Dynamic.

Treatment of Randomness: Casualties, damage and productivity: Monte Carlo.

Sidedness: One-sided, reactive.

LIMITATIONS: Primarily a manual simulation with some computer assistance.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Upgrade of automation FY95.

INPUT: Scenario, to include all combat and logistical data are available at start of exercise.

OUTPUT: Produces move distance on a computer terminal.

HARDWARE AND SOFTWARE:
Computer: IBM compatible PC with 20MB hard drive.
Peripherals: None.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:
Time Requirements: Setup and takedown time is 1 hours.

Frequency of Use: Bimonthly.

Users: U.S. Army Truck Companies.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: TRAP - Ada Trajectory Analysis Program.

DATE IMPLEMENTED: 1988.

MODEL TYPE Analysis.

PROPONENT: ASD/RWAS.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1 Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: TRAP is a general purpose model which simulates three vehicles; a launch aircraft, a missile, and a target. It is built around a detailed flyout model for the missile with simplified launch aircraft and target models.

DESCRIPTION: TRAP is a multi-function three vehicle engagement simulation capability for airborne or ground launch platforms and targets and aerodynamic missiles. TRAP features point-mass modeling capability for one through three vehicle flyouts or intercepts, a complete six-degree-of-freedom modeling capability for the missile and its subsystems, a missile performance reconstruction evaluator, and an error analysis package for statistical evaluation.

INPUT: The TRAP trajectory program requires several major sets of inputs. These input files must be set up prior to execution of TRAP. The major sets of input can be broken down into three logical groupings or logical sections of TRAP: Preprocessor Inputs: Vehicle Definitions, Flyout Performance Definitions, Performance Reconstruction Inputs, and TRAP Inputs That Define Outputs. TRAP Free Format Inputs. Tables.

TRAP executes in two distinct steps or processes. The first involves input collection and editing of all user input files by the input processor. These files are preformatted so the user need only fill in the blanks while editing or creating input files. This first process inputs the preprocessor input files and outputs free format files to Ada logical UNITS 3, 4, and 7, which then become inputs to the second TRAP procedure, the actual simulation.

The preprocessor inputs include vehicle definitions, flyout performance definitions, performance reconstruction inputs if being used, and TRAP program inputs which define TRAP program outputs. The vehicle inputs define the launch aircraft, missile and target. Currently, the missile requires the most data input because of its detailed model representation. Flyout performance requires user input via the RUN SCENARIO file and user written Ada routines such as POLICY. An automated multiple flyout control file is required if any of the automated multi-trajectory flyouts are executed. Performance reconstruction requires an SOBSRV missile input file, OBSERVATIONS DATA input via tables and user written Ada routines. Finally, all printing and plotting can be controlled by user input via the input files that control the program's output.

TRAP free-format inputs include all user input data that is needed for the simulation to execute. The preprocessor input process is not needed if test cases have been set-up in the free-format input files. These files can be edited, but require detailed knowledge of the data and its position within the free-format file. Ada logical UNIT 3 contains all the missile data, while Ada logical UNIT 4 contains scenario and control data.

Table data is read during the simulation. The table values needed by TRAP for each particular simulation can be user-selected by editing the appropriate preprocessor input file. For a more detailed description of inputs see the TRAP User's Manual October 1985 by ITI.

OUTPUT: There are four different types of outputs generated by the TRAP program. These types include the following:

Normal Output Files: TRAP outputs three files for every run. These files contain all of the engineering output and data involved in these runs. Normal Output files are identified by the CMS LISTING file type and have the following names:

- OUT-----LISTING A.
- ERR-----LISTING A.
- TAB-----LISTING A.

where the dotted lines indicate a user specified five letter USER-ID.

File Containing TRAP Inputs: TRAP executes in two processes, one being the input and checking of input data and the other being the actual run. In the first process the input data is put into an input data file which is later read during the run. The input data can be found under the CMS filename of IN-----DATAS A.

TRAP also outputs any user source routines that have been included for the simulation. POLICY and any other user-written subroutines will have source included in the IN-----FORTRANS A output file.

Plot File: TRAP will only output information to plot files if the user has chosen the "SAVE RESULTS IN PLOT FILE" option. This file contains the user-specified variables in PRTVAR. This file can be used as input to any plotting package. Under CMS, the file name is PLT-----DATA A.

Launch Envelope Plot File: TRAP outputs this file if the launch envelope generator has been setup under the automated trajectory flyout control. Any of the launch envelope techniques (LAR by boundary grid, TAR by boundary or grid) are included. Under CMS the file is named TYP-----DATA A.

For a more detailed discussion of the output see the TRAP User's Manual.

HARDWARE AND SOFTWARE:
Computer: VAX.
Language: Ada (Fortran also available).
Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 30 minutes to 1 hour; Typical run time: Dependent on the types of simulation being performed.

Users: SAIC.

TITLE: TRICIA - Theater Attrition Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Analytic Model: Air Force Studies and Analyses Agency (AFSAA/SAG), Pentagon, Rm 1D380, Washington, DC 20330-5420

POINT OF CONTACT: Maj Troy (AFSAA/SAG), DSN 224-4247 or Commercial (703) 614-4247.

PURPOSE: The TRICIA model is a research and evaluation tool used to determine relative aircraft attrition caused by RED surface-to-air threats.

DESCRIPTION:

Domain: Air and land.

Span: Accommodates any theater depending on the data base. Primarily used in the European Theater.

Environment: Models day and night operations.

Force Composition: Single- or multi-ship flight of BLUE air-to-surface aircraft (identical aircraft only) in a RED threat environment.

Scope of Conflict: Conventional warfare; air-to-surface missions.

Mission Area: Conventional fighter aircraft on air-to-surface missions (i.e., CAS, BAI, and AI).

Level of Detail of Processes and Entities: Can determine the relative attrition of different BLUE aircraft (one or more aircraft within a single flight) versus a given RED ground threat.

CONSTRUCTION:

Human Participation: Required for decisions and processes. All data input accomplished prior to each execution of the model.

Time Processing: Dynamic, no time- or event-steps.

Treatment of Randomness: Deterministic.

Sidedness: One-sided.

LIMITATIONS: Does not model force packaging.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None.

INPUT: Threat laydown (within generic cells vs specific geographic coordinates), very specific threat capability descriptions and single-shot Pks, and aircraft characteristics (RCS, IR signature, optical cross-section, maneuverability, threat awareness, ECM capability, etc.).

OUTPUT: Computer printouts with attrition, detection, shop, and individual threat summaries.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on any FORTRAN-capable machine.
Storage:	200-250K required for each data input set; 3-50K for each output file.
Peripherals:	Terminal and printer.
Language:	FORTRAN.
Documentation:	No documentation available.

SECURITY CLASSIFICATION: Source code is Unclassified; threat data base is Secret/NoForn/NoContractor.

GENERAL DATA:

Data Base: Several man-days to several man-weeks, depending on size of effort. Requires output from other models such as ESAMS and RADGUNS.

CPU time per Cycle: 10-15 seconds.

Data Output Analysis: N/A.

Frequency of Use: Varies with user. Several times per month within AFSAA/SAG.

Users: AFSAA/SAG, TAC/XP-JSG.

Comments: TRICIA is an in-house model and is not available for distribution.

TITLE: TSAR - Theater Simulation of Airbase Resources.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis.

PROPONENT: RAND - Mr. Don Emerson, (213) 393-0411.

POINT OF CONTACT: Mr. Robert Hume, (904) 882-9113/4, AV 872-9113/4.

PURPOSE: TSAR analyzes interrelations among the resources associated with a set of airbases. With input from TSARINA, TSAR further analyzes the airbases capability to generate aircraft sorties in a wartime environment. TSAR can be used as either a research and evaluation tool or an operations support tool. It can determine weapon systems effectiveness and all aspects of force capability, as well as develop new or revised doctrine.

DESCRIPTION:

Domain: Land and Air.

Span: Accommodates any theater depending on data bases.

Environment: Simulates time of day over a designated sequence of days; meteorological conditions; day and night operations; availability and repair status of TOLS, buildings, and 11 classes of resources; and geography (location and size of TOLS and facilities).

Force Composition: Simulated RAND air and ground attacks on BLUE base resources, facilities, and aircraft (or reverse scenario). Can model cross-trained personnel and reserve support.

Scope of Conflict: Conventional and chemical weapons attacks simulated when TSARINA input used. Conventional weapons loading on sorties generated from modeled base(s) simulated.

Mission Area: Simulates any type of aircraft mission via weapons statistics on weapons loading, probabilities of kill and change, and flight resources.

Level of Detail of Processes and Entities: Can model resources and tasks for 1 to 63 airbases that can be subdivided into squadrons of aircraft and shops. Asset accounting completed for each type of resources, by base, within 11 classes of resources. Aircraft, aircrews, fuel trucks, facilities, and repairable spare parts monitored individually; all others handled in more aggregate terms.

CONSTRUCTION:

Human Participation: Not permitted. Updates to data deck completed easily.

Time Processing: Dynamic, time- and event-step.

Treatment of Randomness: Monte Carlo, discrete-event. Random number generator can reproduce seed values for trials used in all model computer runs or select seed values randomly.

Sidedness: Two-sided, asymmetric, one side nonreactive, reversible.

LIMITATIONS: Does not consider results of damage or demolition of utilities except electrical of base communication systems.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements in the latest version affect input and output procedures and capabilities, parts and equipment repair, pre- and post-flight procedures, sortie supply and demand logic, chemical ensembles at different bases, airbase attack munitions, aircraft attrition and transfer directives, and dispersed operating bases.

INPUT: TSAR data base: primary control data, task criticality and aircraft status, resource requirements, initial stocks of resources, intratheater and CONUS shipment schedule, airbase facility and attack tables, initialization of aircraft and shop status, chemical warfare effects, and sortie demand data.

OUTPUT: In-depth statistics and information specified via TSAR input control data. Summary reports and plots can be produced indicating sortie generations from one or more scenarios and target impacts on TOLS and facilities.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on an IBM (370/3032), but is compatible with a VAX computer with a VMS operating system or any 32-bit-word machine with enough storage.
Storage:	Approximately 3 MB required. An additional 400 to 1600 KB is required for data base storage.
Peripherals:	Terminal; printer and plotter for summary reports.
Language:	FORTRAN 77.
Documentation:	Three user's guides published by RAND: Program Features, Logic, and Interactions; Data Input, Program Operations and Redimensioning, and Sample Problem; and Variable and Array Definitions and Other Program Aids, Sept. 90; and the December 1990 TSAR-TSARINA Documentation Update.

SECURITY CLASSIFICATION: Unclassified, but data bases can be classified.

GENERAL DATA:

Data Base: Gathering valid data can be time-consuming. Modifying data is accomplished by editing input file with appropriate values.

CPU time per Cycle: Depends on scenario and control option. Can range from several minutes to half an hour.

Data Output Analysis: Output from TSAR can be massive, but is relatively easy to understand and operationally valuable. Utility programs and plots can pull specific sortie and base damage information from output.

Frequency of Use: Used as often as daily by organizations listed below.

Users: Air Base Operability, Logistics and Plans and Programs in U.S., UK, FRG.

Comments: New version released by RAND in early 1991.

TITLE: TSARDOSE - Theater Simulation of Airbase Rerources DOSE.

DATE IMPLEMENTED: 1983-1985.

MODEL TYPE: Analysis.

PROPONENT: AL/CFHD, Wright-Patterson Air Force Base, OH 45433-6573.

POINT OF CONTACT: Dr. C.R. Replogle, DSN 785-7583, Commercial (513) 255-7583.

PURPOSE: TSARDOSE simulates the agent challenge time history data from multiple attacks with chemical weapons. The output from the TSARDOSE model is sometimes used as input to high-level analysis models such as CWTSAR.

DESCRIPTION:
Domain: Land.

Span: Local.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: Chemical Warfare.

Mission Area: Airbase operations.

Level of Detail of Processes and Entities: TSARDOSE uses the contamination pattern produced by a single munition (output from a chemical transport-diffusion model such as NUSSE 4) to overlay and determine the chemical challenge time history data for each x,y,z monitoring point in the target grid. The target area may be subdivided into multiple subtargets. The contamination pattern overlay is onto a grid of user specified resolution. The contamination values at each x,y,z grid point and within each grid sector are used to compute the chemical challenge history data of area coverage versus deposition, concentration, dosage throughout the target area.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, attack times specified.

Treatment of Randomness: Stochastic Monte Carlo representation of multiple trials.

Sidedness: One-sided.

LIMITATIONS: All monitoring points must be at the same altitude (z) within the same run.

INPUT: Agent dispersion patterns, target data, attack scenario (attack times, weather, munition targeting, delivery techniques, and errors).

OUTPUT: Chemical challenge history data (dosage, deposition, droplet deposition time event list).

HARDWARE AND SOFTWARE:
Computer(OS): Any system with a FORTRAN compiler.
Storage: 10 MB.
Peripherals: None required.
Language: FORTRAN 77.
Documentation: User Guide, self-documented code.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: No data base required.

CPU time per Cycle: Generally less than 20 minutes, depends on number of monitoring points in target grid.

Data Output Analysis: Postprocessor aids in analysis of output data.

Frequency of Use: Monthly.

Users: JAYCOR.

Comments: Model developed by JAYCOR, Dayton, Ohio, under USAF contract to AL/CFHD, WPAFB, OH.

TITLE: TSARINA - Theater Simulation of Airbase Resources (TSAR) INputs Using Airbase Damage Assessment model.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analytic input to TSAR.

PROPONENT: RAND - Mr. Don Emerson (213) 393-0411).

POINT OF CONTACT: Mr. Bob Hume, (904) 552-9113/4, AV 872-9113/4.

PURPOSE: TSARINA may be used as a general-purpose, complex-target damage assessment model, although its intended primary role is to support the TSAR aircraft sortie generation simulation program. When used with TSAR, TSARINA can assess multiple trials of a multibase airbase attack campaign. The impact of those conventional and/or chemical attacks on sortie generation can be derived using the TSAR model. TSARINA can be used as either a research and development tool or an operations support tool. TSARINA output depicts how weapons damage the simulated bases resources, aircraft, and facilities after one or a series of attacks.

DESCRIPTION:

Domain: Although this model considers processes both on land and in the air, generated results pertain to occurrences on land.

Span: Accommodates simulation of an individual base, a set of independent bases, or a set of interdependent bases. Data bases developed include specific Central European and United Kingdom bases as well as generic Central European, United Kingdom, SW Asian, and PACAF regions.

Environment: Simulates activities over a day or series of days; meteorological conditions to include temperature, wind velocity and direction, and atmospheric stability; and geography consisting of location and size of take-off and landing surfaces (TOLS) and facilities.

Force Composition: Simulates effects of RED attacks on BLUE airbase resources, aircraft, and TOLS. Scenario can be reversed.

Scope of Conflict: Attacks to base(s) can be conventional or chemical.

Mission Area: Simulates effects of hostile attacks to base(s).

Level of Detail of Processes and Entities: TSARINA models individual entities as resources of a specified airbase. Different mean areas of effectiveness or kill probabilities can be defined for different resources, and a two-level "cookie cutter" can be used to represent the effectiveness of weapons against the several classes of resources. Delivery parameters help determine the arrival location of the weapons while Monte Carlo procedures determine which weapons arrive at the target.

CONSTRUCTION:

Human Participation: Not permitted. Updates to data base completed easily.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric, reversible.

LIMITATIONS: Does not currently consider damage to utilities, except electrical, or to base communication systems.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Subsequent attacks on MOS; aircraft shelter damage and increased vulnerability for impacts in front of shelter doors; simulation of unexploded ordnance detonations, and additional types of conventional munitions.

INPUT: The TSARINA data base consists of control data, target data, MOS data, attack scenarios, resource designators, chemical effects of monitoring point data, and weapons delivery and effectiveness parameters.

OUTPUT: Statistical results: targets hit, average losses of resources at each target, average of the initial surface deposition of chemical agents, and a summary of runway closures required repairs to meet MOS requirements.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on 32-bit-word machines.
Storage:	Requires approximately 127 KB for the executable program and 200 KB for the data base. Output for TSAR requires approximately 1 MB.
Peripherals:	Terminal connected into computer system; printer and plotter for summary reports.
Language:	FORTRAN 77.
Documentation:	User's guide published by RAND, TSARINA--A Computer Model for Assessing Conventional and Chemical Attacks on Airbases, Sept. 90, and the December 1990 TSAR-TSARINA Documentation Update.

SECURITY CLASSIFICATION: Unclassified, but data bases can be classified.

GENERAL DATA:

Data Base: Modifying data is accomplished by editing the data file with appropriate values. Gathering valid data can be time consuming.

CPU time per Cycle: Changes with options selected. Increases with large number of trials and chemical attack processing. Run can take from a few minutes to a half hour.

Data Output Analysis: Summary output lists easily readable input data and hit summary by trial. Optional output plots location of craters and MOS.

Frequency of Use: Used when testing a new base or region. Once established, can be used, usually without modification, to test operational procedures or equipment modification with TSAR.

Users: Air Base Operability, Logistics, and Plan and Programs in the U.S., UK, FRG.

Comments: Latest version released by RAND in 1991.

TITLE: TSP - Tactical Sensor Planner.

DATE IMPLEMENTED: July 1987.

MODEL TYPE: Analysis.

PROPONENT: AFEWC/SAI.

POINT OF CONTACT: Capt Mark Edwards, DSN 969-2729/4905.

PURPOSE: Operation Support Tool (Decision Aid).

DESCRIPTION.
Domain: Operates on any IBM compatible microcomputer (PC) with 8088, 80286, 80386, or 80486 microprocessors, CGA or EGA graphics, greater than 10 MBytes of hard disk space, 640 KBytes of memory, and a math coprocessor.

Span: Uses world political map and 15 second digitized terrain.

Environment: World boundary, 2-D terrain relief, and 3-D terrain displays.

Force Composition: Combined forces.

Scope of Conflict: Red, Grey, or Blue conventional weapon envelopes integrated with line-of-sight (LOS) analysis.

Mission Area: Effective for radar threat analysis, weapon placement, and flight mission planning to include fighter, airlift, and rescue scenarios.

Level of Detail of Processes and Entities: Single or multiple radar LOS against single aircraft elevations or multiple aircraft routes.

CONSTRUCTION:
Human Participation: Required for decisions and processes, waits for decisions.

Time Processing: Static.

Treatment of Randomness: Deterministic (no randomness).

Sidedness: One-sided.

LIMITATIONS: Requires intelligence data feed and digitized terrain for desired area of analysis.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Automated intelligence feeds, VGA graphics capability, radar parametrics and range calculations, and display of jamming effects.

INPUT: Electronic order of battle, scenario definition, weapon threat envelopes, flight route description.

OUTPUT: Scaled overlay plots, color screen printouts, hardcopy file printouts, flight route interface to Air Force fuel planning software (FPLAN 8.2).

HARDWARE AND SOFTWARE:
Computer (OS): 8088 up to 80486 PCs using MS-DOS 3.2 or higher.
Storage: Minimum of 10 MBytes.
Peripherals: Air Force standard computer contract peripherals.
Language: FORTRAN/Assembly language graphics.
Documentation: Yes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Dependent on user.

CPU time per Cycle: 4 - 50 MHz.

Data Output Analysis: Dependent on user.

Frequency of Use: Daily.

Users: All Air Force MAJCOMS, some Army field units.

Comments: TSP integrates with FPLAN, Weapons Delivery, and Cartridge Interface to produce Tactical Mission Planner (TACMIPS), a computer to cockpit planning system currently being validated for F-16s.

TITLE: TSTM - Terrain Surface Temperature Model.

DATE IMPLEMENTED: 1990.

MODEL TYPE: Analysis.

PROPONENT: Waterways Experiment Station (WES), Vicksburg, MS.

SPONSORED BY: (Through the SWOE/BTI effort); CECOM Center for Night Vision and Electro-Optics; Attn: AMSEL-RD-NV-VMD-TST, Ft. Belvoir, VA 22060-5677.

POINT OF CONTACT: Hung Hguyen, C2NVEO, DSN 354-4074; Comm (703) 664-4074.

PURPOSE: To predict thermal backgrounds (validated for Ft. Hunter-Liggett, CA area). C2NVEO uses TSTM in its three dimensional synthetic scene generation.

DESCRIPTION:

Domain: Background features (trees, grass, and soils).

Span: Accommodates several different spectral bands (e.g., 3-5 and 8-12 micron) for its predictions. It is able to use weather data from various geographical areas.

Environment: Code is developed for specific machines (e.g., there is a Silicon Graphics version as well as a SUN version. Models diurnal cycles of background features.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: Three-Dimensional synthetic thermal scene modeling.

Level of Detail of Processes and Entities: A. Background File Construction: Precise composition and orientation of feature data is required to accurately thermally model a ground surface area. B. Execution of TSTM Model: Setup for execution of TSTM requires accurate and detailed meteorological information. Scenario descriptions must be known to provide information concerning latitude and longitude of test site.

CONSTRUCTION:

Human Participation: Required for processes.

Time Processing: Dynamic, time- and event-stepped model. Progresses through set number of diurnal cycle intervals that have been user defined.

Treatment of Randomness: TSTM is basically a deterministic model.

Sidedness: N/A.

LIMITATIONS: Limited by the topological information known about the background; such as, tree types, soil types and depths, etc.

PLANNED IMPROVEMENTS AND MODIFICATIONS: None planned.

INPUT: Background feature files. Meteorological files.

OUTPUT: Tabular files of thermal predictions.

HARDWARE AND SOFTWARE:

Computer(OS):	Silicon Graphics IRIS 4D GTX parallel processing graphics workstation. UNIX based operating system.
Storage:	Hard disk required (approximately 80 Mbytes).
Peripherals:	Laser Printer.
Language:	Believed to be FORTRAN 77 and C subprograms.
Documentation:	Available from WES.

SECURITY CLASSIFICATION: Unclassified, but restricted distribution to licensees for the source code of TSTM.

GENERAL DATA:

Data Base: 16 hours.

CPU time per Cycle: Depends on the complexity of the background and the length of the thermal cycle duration.

Data Output Analysis: Tabular thermal file of predictions created with mean and standard deviation calculated.

TITLE: TTSM - Theater Transition and Sustainment Model.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Training and education (under development).

PROPONENT: HQ USAFE Warrior Preparation Center (WPC), Einsiedlerhof Air Station, Einsiedlerhof, Germany APO AE 09094-5000.

POINT OF CONTACT: Mr. Bobby Kelley, (49) 631-536-6507, DSN 489-6507.

PURPOSE: TTSM will function as a command post exercise driver. It will model wartime support activities that occur during the transition to war and during combat in theater rear-area operations.

DESCRIPTION:
Domain: Primarily theater, rear-area.

Span: Initially European theater-level, but design will allow it to be adapted to other theaters.

Environment: A node and link network representation.

Force Composition: Joint and combined forces and host nation civilian support agencies.

Scope of Conflict: Rear-area conflict will be determined by the combat model used as the combat driver.

Mission Area: Combat Service Support (Theater, rear area).

Level of Detail of Processes and Entities: Variable depending on the mission-area modules to be played. The design permits the level of resolution to be set in conjunction with the objective of the exercise to be supported. All functional modules have not been implemented at this time. Current modules include intratheater transportation, logistics and personnel. Functionality exists to support single area support group, forward reception, and onward movement exercises. Future modules to be designed may include maintenance, medical, COMM, INTEL, RACO, and engineer.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Basically deterministic in that it determines values from data base information. Randomness applications have not been determined.

Sidedness: The TTSM mission-area modules will be one-sided in their stand-alone mode. However, when TTSM modules are used in conjunction with an exercise involving the interaction with a combat model, the modules can be considered assymmteric. TTSM will not affect RED logistics play but will impact indirectly on the RED combat operations through the combat model.

LIMITATIONS: TTSM modules will only simulate theater, rear-area functions. It is not a combat resolution model.

PLANNED IMPROVEMENTS AND MODIFICATIONS: The model is at the Initial Operational Capability development phase. Fielding will be accomplished as each version is approved. A TTSM IOC validation will be conducted in October 1991.

INPUT: Relational data bases (RDBs) must be developed for each mission-area module. INGRES is the standard RDB system being used for development.

OUTPUT: Computer printouts and CRT reports of event occurrences as well as preformatted standard reports and ad hoc queries.

HARDWARE AND SOFTWARE:

Computer:	Designed so that all operate on a single VAX computer with a VAX/VMS operating system. The configuration includes a central data base. Operation can be stand-alone using an internal events generator module, or interfaced with the WPC DWS to accomplish combat events for promoting decision making.
Storage:	Depends on size of data bases.
Peripherals:	Minimum requirements: one printer and five VT220 terminals.
Language:	Written in "C" with embedded INGRES SQL.
Documentation:	The final documentation requirements have not been determined. Current plans call for users manuals, scenario development guides, and a data requirements guide.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Frequency of Use: Unknown.

Users: WPC and USAREUR.

Comments: Currently the model operates on a single system.

TITLE: TW/AA End-to-End Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis (can also be used for training).

PROPONENT: AFSPACECOM/XPW, Peterson AFB, Colorado Springs, CO.

POINT OF CONTACT: Bill Teague, Teledyne Brown Engineering, (719) 574-7270.

PURPOSE: As a research and evaluation tool, the TW/AA model is used to analyze the response of the current TW/AA system to user-defined scenarios. It can also be used to estimate the effects of future system upgrades. As an operating tool, the model can support real-time test exercises by a prior determination of the expected response. In addition, the model can be used for training and education by emulating the five common command center displays or by driving the actual missile warning hardware and software of the NCS.

DESCRIPTION:

Domain: Missile warning (land, space, and sea).

Span: Global threat (currently USSR).

Environment: Spherical Earth, benign or stressed environment (nuclear jammers).

Force Composition: Currently RED (USSR) ICBM and SLBM data base.

Scope of Conflict: Nuclear weapons.

Mission Area: Tactical warning and attack assessment, missile warning mission.

Level of Detail of Processes and Entities: Radar (beam scheduling, signal processing surrogates, and message generation), space-based sensors (focal plane processing and message generation), communications (message length and content; protocols, buffers, network media and topology; and message routing stress effects), and command centers (message processing by type and five command displays).

CONSTRUCTION:

Human Participation: Not permitted, except for run setup and operation of command center displays.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, asymmetric, one side nonreactive.

LIMITATIONS: 1000 boosters.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Update to early 1990s TW/AA configuration.

INPUT: Threat scenario, TW/AA configuration.

OUTPUT: Computer printouts, plots, and display hardcopy.

HARDWARE AND SOFTWARE:

Computer: VAX/VMS.

Storage: Data bases/executables: 15 MB; Simulation execution files: 25 MB (100 boosters).

Peripherals: Line printer and Megatek or Tektronix graphics terminals.

Language: FORTRAN 77.

Documentation: Complete user and maintenance documentation.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:

Data Base: Several man-months if generated from scratch.

CPU time per Cycle: Up to 24 hours for 1000 boosters, 40,000 objects.

Data Analysis Output: Several days.

Frequency of Use: Unknown.

Users: AFSPACECOM, USASDC, The Joint Staff/J-8.

Comments: Models TW/AA system as of 1986; composed of separate computer programs that run in sequence; missile warning mission of TW/AA.

TITLE: TWSEAS - Tactical Warfare Simulation, Evaluation and Analysis System.

DATE IMPLEMENTED: 1977.

MODEL TYPE: Training and education.

PROPONENT: Marine Corps Wargaming and Assessment Center (WG06), MCCDC, Quantico, VA 22134-5001.

POINT OF CONTACT: Capt. T.J. Reeves, (703) 640-3276, AV 278-3276.

PURPOSE: TWSEAS is a computer-assisted, command and control, war game-based training system designed to support Marine Corps war games, troop landing and field maneuvering exercises, and staff-oriented training games. Through battle simulation, TWSEAS provides a realistic, real-time environment that will allow the commander and staff to practice staff functioning and decision making. In addition, it provides the Tactical Exercise Control Group with a vehicle that manages and controls all levels of command post exercises in a cost-effective manner.

DESCRIPTION:

Domain: Land, sea, and air.

Span: TWSEAS will support individual, local, or regional data bases.

Environment: Square-based. 1200 km on a side. Positioned within that square is a 100 km square containing a digital terrain data base. Eight filler zones are used to complete the 100 km square if the digital terrain does not fill up the entire 100 km. The remainder of the 1100 km x 1000 km forms an 11 x 100 km square tabletop. Each tabletop square can be individually designated at various vegetation and trafficability values. Factors such as time of day, weather, and barriers are utilized to influence the speed of unit movement.

Force Composition: One exercise staff playing the landing force and the controller playing the opposing force, or an exercise, or an exercise staff for each side. CPXs can range from low level, company or platoon, to high level, MEB or MEF.

Scope of Conflict: Conventional weapons.

Mission Area: All conventional missions except unconventional warfare.

Level of Detail of Processes and Entities: An addressable unit is considered to be either a ground unit or a surface fire support ship. There are 256 addressable units allowed in the exercise. A ship is represented as a circle with the center point as the current location. It is subject to casualty damage assessment. The representation is more complex for ground units. A ground unit can be configured with a wide array of formations and various sizes. Several missions ranging from highly offensive to highly defensive, may be assigned to any unit. These missions, from most offensive most timid, are seize, move, recon, defend, and withdraw.

Rotary and fixed-wing aircraft are addressable in terms of having commands to modify their original mission and to obtain information about them.

CONSTRUCTION:

Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time-driven model. Ratio can be changed from real time to allow many days of gaming to occur in a single day.

Treatment of Randomness: Probability of hit and kill are determined stochastically. Outcomes are nondeterministic.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: System will be replaced with MAGTF Tactical Warfare System (MTWS) in FY93.

INPUT: Combat orders, as transmitted by the player staffs, are reduced to prescribed message formats for acceptance by the computer and entered through terminals.

OUTPUT: Event-oriented solicited and unsolicited reports are generated in the form of messages at the appropriate terminals and reinforced at graphic displays.

HARDWARE AND SOFTWARE:

Computer:	AN/UYK-7.
Storage:	229,376 words of memory.
Peripherals:	2 CPUs and 16 channels.
Language:	CMS-2.
Documentation:	Employment manual.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: A week to prepare large data bases.

CPU time per Cycle: Dependent on data base size and player configuration.

Data Output Analysis: Manual analysis conducted by TACEX staff.

Frequency of Use: Varies by each user based on training requirements and availability. Total use of the system is generally monthly.

Users: Fleet Marine Force and formal schools at MCCDC.

Comments: None.

TITLE: TWSM - Tactical Warning Simulation Model.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: HQ AFSPACECOM/CNS, Bldg 1 Stop 7, Peterson AFB, CO 80914.

POINT OF CONTACT: David Remy, AV 692-3359, Commercial (719) 554-3359.

PURPOSE: The TWSM is a combination research & evaluation and operation support tool. The TWSM is a tool to be used for comprehensive analysis of the missile warning function of the Tactical Warning/Attack Assessment (TW/AA) system, any portion of the system, or a component of the system. The model can be used to estimate the TW/AA system sensitivities to threat size, types, timeliness, densities, etc., in both a stressed and benign environment. Sensor data output quantity and timeliness, which affect the loads on the communication system, can be estimated.

DESCRIPTION: The TWSM consists of a series of software modules whose execution is controlled by the preprocessor. These modules are medium fidelity representations of the ground and space-based sensors, including BMEWS, PAVEPAWS, PARCS, COBRA DANE and DSP, and the communication network comprising the TW/AA system. Missile trajectories are input through the preprocessor and form scenario and threat files. The scenario is then run against any combination of sensors which in turn generate messages with content.

CONSTRUCTION:
Human Participation: Required to configure runs.

Time Processing: Dynamic, time- and event-stepped model. Keeps track of scenario and message time. Communication delays are also simulated. Not a real time model.

Treatment of Randomness: Deterministic, random number seeds built into the software.

Sidedness: Presently one-sided. Could be upgraded to two-sided by modifying data bases.

LIMITATIONS: 1) Limited fidelity of sensor models; 2) Scenario is limited in duration to 24 hours; 3) Futures sensors not modeled.

PLANNED IMPROVEMENTS AND MODIFICATIONS: 1) Update IR and radar cross section data bases; 2) Upgrade BMEWS site III model; 3) Upgrade DSP model; 4) Update communication configuration.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with VMS operating system.
Storage:	400k blocks.
Peripherals:	No special devices required.
Language:	FORTRAN 77.
Documentation:	Users manuals, maintenance manuals.

SECURITY CLASSIFICATION: Secret.

GENERAL DATA:
Data Base: Required data bases are included.

CPU time per Cycle: Varies on the size of the scenario and sensors simulated, 15 minutes to 20 hours.

Data Output Analysis: Postprocessor aids in analysis of output.

Frequency of Use: Used several times a month.

Users: AFSPACECOM, U.S. Army Strategic Defense Command.

TITLE: UBS - Underwater Battle Simulation.

DATE IMPLEMENTED: 1989.

MODEL TYPE: Analysis.

PROPONENT: Martin Marietta Corporation (Aero and Naval Systems), 103 Chesapeake Park Plaza, Baltimore, MD 21220.

POINT OF CONTACT: Edward J. Roth, (301) 682-1577.

PURPOSE: The UBS is a Monte Carlo simulation for effectiveness and survivability studies. The model is used to conduct tradeoff studies and to select performance requirements.

DESCRIPTION:
Domain: Models underwater and surface warfare (air implicitly).

Span: Local combat scenarios; may be used for regional or theater operations analysis.

Environment: The environment is included via input files.

Force Composition: Models multi-sided scenario; combatant platforms, weapons and countermeasures.

Scope of Conflict: Unconstrained except for input performance values.

Mission Area: ASW; there are no real constraints to usage.

Level of Detail of Processes and Entities: Processes are driven by input tactics sets for each unit (platform, weapon or countermeasure). These tactics can be predetermined and/or reactive. Movement is performed by kinematic equations. Submarines, surface ships, torpedoes and countermeasures have been modeled thus far. Attrition is controlled by an input number-of-hits-to-kill value for each unit, which allows for weapon effectiveness to be applied outside or within the model. The probabilities of weapon launch, enable and kill are compared with draws from a random number routine contained in the model. Draws may be either uniform or normal. An important feature of the model is the high level of detail to which sensor systems can be modeled. At the highest level of detail, the standard sonar equations (passive and active) are used to determine detections. All applicable geometries, physical factors and fluctuations are applied at the appropriate time.

CONSTRUCTION:
Human Participation: No human interaction during processing; all decisions are programmed into the run in the input tactics sets. Units react to the actions of other units through tactics sets.

Time Processing: The model is a dynamic, hybrid time-step/event-step simulation. Maximum time-step values are set in the input structure; some areas are event driven. Top level subroutines are entered every time-step, updates are made, and the event list is checked for events due to be processed.

Treatment of Randomness: The model is constructed as a stochastic model with an option to run deterministically (either fully or partially).

Sidedness: The principal use of the model is two-sided, but there is no limitation.

LIMITATIONS: Communications systems are not currently modeled. All units are modeled as points (rather than bodies). The model does not perform any hydrodynamic calculations.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Extend the countermeasure modeling. Extensions to postprocessing and output commands are being added.

INPUT: Data relating to specific units is loaded via inputs files. This data includes kinematic values, sensor information, environmental parameters and other data to model the platforms, weapons and ocean. An input guide is available on request.

OUTPUT: Output data is written to a binary file at appropriate times throughout execution. A variety of postprocessing programs give the user statistical and graphical outputs.

HARDWARE AND SOFTWARE:

Computer: Currently running on DEC VAX systems (VMS installed).

Storage: The source codes, executable images and input data files require approximately 5000 blocks. The output from any single run can range from a few hundred to tens of thousands of blocks. The user's process paging quota must be set to 50000 due to the large arrays necessary in the model.

Peripherals: The video requirement is any terminal equivalent or superior to a DEC VT100. Graphics are currently done using NCAR routines combined with some translation routines. Current hardcopy graphics are done using a DEC LN03 Plus, while video graphics are sent to a Tektronics model 4111. All data necessary for graphics is contained in the output file.

Language: The model is written in VAX FORTRAN (77 Extended).

Documentation: Top-level documentation on model structure, detailed description of the sensor sections and a detailed user input guide.

SECURITY CLASSIFICATION: The model is unclassified; input files may be classified.

GENERAL DATA:

Data Base: No general data base exists, and all inputs are taken from user-created input files.

CPU time per Cycle: Generally runs faster than real time. A sample run of 400 iterations was made with a game time of ten minutes each, five units modeled, an update rate of .5 to 1 second on average, and the sensor detail level set to cookie-cutter mode. This set took approximately 3 1/2 hours of CPU time, yielding a ratio of about 19:1 (game time:CPU time). The sample run was made on a VAX 3300 (2.4 VUPS, Q-bus, DSSI).

Data Output Analysis: Programs exist for analysis of several scenarios. The outputs from these address MOEs specific to the analyses.

Frequency of Use: The UBS is used regularly.

Users: Martin Marietta Aero and Naval Systems and the Naval Surface Warfare Center (NSWC/WO).

Comments: Modified and updated on a continuing basis.

TITLE: UCCATS - Urban Combat Computer Assisted Training System.

DATE IMPLEMENTED: 1991 (latest version September 1991).

MODEL TYPE: Although UCCATS is primarily being used for training and education it can also be used for analysis.

PROPONENT: Conflict Simulation Laboratory, Lawrence Livermore National Laboratory, P.O. Box 808 L-315, Livermore, CA 94550.

POINT OF CONTACT: Dr. Ralph Toms, (510) 423-9828.

PURPOSE: UCCATS was developed as an exercise driver and skill development tool. UCCATS is intended to be used to train platoon leaders through battalion commanders in urban warfare. In addition, it can be used as a command post exercise driver and seminar exercise driver.

DESCRIPTION:

Domain: Land with limited air and naval operations.

Span: The largest use has been a 26 kilometer square area though larger areas are possible. The smallest use for training has been a 400 meter square area.

Environment: Rectangular grid for elevation data. Feature data is overlaid on top of the terrain grid in the form of tiles or vectors. Features include rivers, roads, foliage, buildings, barriers and mine fields. The exterior of each building can be modeled explicitly (i.e., wall location, construction type and number of floors are specified for each building). Building interiors are implicitly modeled. Weather is variably defined but constant during duration of play. Day operations only.

Force Composition: Conventional or unconventional forces. Blue, Red and Green (civilian).

Scope of Conflict: Conventional warfare, unconventional warfare, and special operations. All data is external and editable by the user so virtually any imaginable conventional weapon may be modeled without the necessity to modify source code.

Mission Area: Both conventional and unconventional warfare has been modeled. Models air-to-ground and ground-to-air combat. Models air-to-air for rotary-wing aircraft only.

Level of Detail of Processes and Entities: Individual [illegible] systems can represent either individual platforms (trucks, tanks, [illegible]ters) or teams of one to fifteen soldiers. There can be up to 2000 syste[illegible] scenario. Orders and plans are given at the game system level. Line [illegible]-sight and acquisition is also done at the system level. All other combat processes are done at the item system level (i.e., the individual soldier level). Attrition is done via probability of hit and kill, Monte Carlo based, and adjudicated at the item system level.

CONSTRUCTION:

Human Participation: Required to enter initial plans and orders. UCCATS can be run in systemic mode without human participants for analysis or it can be run in interactive mode with humans interacting and changing plans at real time.

Time Processing: Dynamic, event-stepped. During interactive play UCCATS is slowed down so that it runs at no faster than real time.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Three-sided, asymmetric. Whether or not forces react depends on whether or not the force has a human player assigned to it. Can be operated with no players (systemic mode), a single player, or as many as 32 players.

LIMITATIONS: Limited to 2000 systems per scenario, either one platform per system or 15 soldiers per system. Maximum terrain resolution is 400 x 400 terrain cells (40 km square at 100 meter resolution, 400 m square at 1 meter resolution). Does not model air-to-air combat for fixed wing aircraft. Does not model undersea operation nor some aspects of ship-to-ship fighting. Does not model explicit clearing or maneuvering of soldiers within buildings.

PLANNED IMPROVEMENTS AND MODIFICATIONS: New, faster algorithms are being developed to allow larger games to be played. Additional features such as capturing enemy systems, air-to-air combat for fixed wing aircraft, CAS, fratricide will be added in the next year of development. Looking at migrating to RISC/UNIX with X-WINDOW systems.

INPUT: All modeling data is external to the model. This includes all weapon and platform characteristics, PH/PK data, terrain, force organization, and force orders and plans. Even the graphic symbology used may be modified by the user.

OUTPUT: Produces formatted positional reports. Also produces event history files which can be used with the Analyst Workstation postprocessor to analyze the results of the game and to create after action reviews. The history file includes movement, combat and attrition, logistics, and intelligence information.

HARDWARE AND SOFTWARE:

Computer:	Will run an any VAX computer with the VMS operating system.
Storage:	80,000 blocks for the UCCATS software itself. 300,000 blocks for users.
Peripherals:	Minimum requirement for analysis: 1 printer, 1 VT-100 compatible terminal, 1 Tektronix 4225 workstation with 8 MBytes of memory and one graph tablet. Add a second 4225 for training. A full-up system has 16 Tektronix 4225 with two graph tablets each.
Language:	VAX Ada, FORTRAN, DCL. INGRES is optional.
Documentation:	Extensively documented with 5 published manuals.

SECURITY CLASSIFICATION: Unclassified, but data bases may be classified.

GENERAL DATA:

Data Base: Initial data bases may take several man weeks.

CPU time per Cycle: Highly dependent on scenario size and computer speed. Company size scenarios typically run faster than real time and have to be slowed down if there are human interactors.

Data Output Analysis: Analyst Workstation (AWS) postprocessor allows after action review within minutes of game completion. Statistical analysis using AWS and provided relational data base may be completed in a few hours.

Frequency of Use: Depends on the individual users. Some use it daily, others weekly, the rest use it on a monthly basis.

Users: Lawrence Livermore National Laboratory, SOUTHCOM, USA Europe 7th ATC and Berlin Brigade.

Comments: UCCATS is joint development effort between Lawrence Livermore National Laboratory and USA Europe 7th ATC. Contributing sponsors include SOUTHCOM and USA Berlin Brigade. Configuration management by Lawrence Livermore National Laboratory which also sponsors annual user group meetings.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: UCPLN - Uniform Coverage Planning, Version 2.3.

DATE IMPLEMENTED: October 25, 1990.

MODEL TYPE: Analysis.

PROPONENT: Mine Warfare Command, NAVSTA BLDG NS-1, Charleston, SC 29408-5500.

POINT OF CONTACT: Mr. Joseph Mattingly, Code N4C (803) 743-5405, AV 563-5405.

PURPOSE: UCPLN is an operational support tool designed for the MCM Commander's staff to provide the capability to plan an MCM operation. The program calculates the amount of effort required to attain a specified clearance level.

DESCRIPTION:
Domain: Sea and undersea.

Span: Local.

Environment: All environmental data is implicitly specified through values users assign during MCM scenario specification.

Force Composition: Naval mines, mine countermeasures vehicles (MCMVs) and EOD.

Scope of Conflict: Conventional.

Mission Area: Sea control.

Level of Detail of Processes and Entities: Individual minesweepers and mines are not explicitly represented. Minesweepers are continuous rather than discrete entities. Mines are represented only in terms of their susceptibility to sweep tactics, and whether or not ship counts are used.

CONSTRUCTION:
Human Participation: Required. UCPLN requires interactive input to specify the problem to be solved.

Time Processing: Dynamic, Closed form.

Treatment of Randomness: Stochastic, direct computation.

Sidedness: Two-sided, asymmetric. One side nonreactive, does not compute expected casualties.

LIMITATIONS: Math routines contained in UCPLN assume all MCM effort applied must be in parallel tracks to a route.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improve user interface, add graphics routines and update algorithms to be consistent with the more rigorous COGNIT algorithms.

INPUT: Data describing intended track, mining threat, MCM system capabilities, navigation error and desired goal (expressed as percent clearance to be attained).

OUTPUT: Printed output of user input values and MCM effort required.

HARDWARE AND SOFTWARE:

Computer(OS):	IBM-Compatible PC (MS-DOS).
Storage:	100K bytes.
Peripherals:	Interactive keyboard, monitor and printer.
Language:	ANSI Standard FORTRAN 77.
Documentation:	COM1NEWARCOM's Zenith MCM Planning and Evaluation Software Operator's Manual dated 25 October 1990. (Being updated by NAVTACSUPPACT.)

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Minutes.

CPU time per Cycle: Minutes.

Data Output Analysis: Minutes.

Frequency of Use: As required during each MCM exercise.

Users: MCM Commander's staff.

Comments: None.

TITLE: URBAT - Urban Battle Trainer.

DATE IMPLEMENTED: 1991.

MODEL TYPE: Training and education.

PROPONENT: Developed by Systems Assessment Group, RMCS Cranfield, on behalf of British Army FIBUA Training Team (FTT).

POINT OF CONTACT:
1) (FTT) OC FTT, C.A.T.C., Warminster, Wiltshire, BA12 ODJ, UK;
2) (RMCS) J.R. Searle, Systems Assessment Group, R.M.C.S., Shrivenham, Swindon, Wiltshire, SN6 8LA, U.K.

PURPOSE: Used at a specialist urban combat training facility, to complement other training means (e.g., field exercises). Used as seminar exercise driver for groups of 10-15 players ranging from section/squad leader to company commander.

DESCRIPTION:
Domain: Land battle (urban operations).

Span: Local.

Environment: Urban area of 600m x 200m, modeled in terms of 2m terrain cells. Terrain features include ground height, buildings, woods and roads. Daytime operations only. No explicit weather effects.

Force Composition: All Arms forces up to battalion in attack and company in defence. Maximum of 220 entities.

Scope of Conflict: Conventional warfare.

Mission Area: The principles of All Arms operations in built-up areas, focusing on the constraints upon and consequences of, tactical operations at the low level.

Level of Detail of Processes and Entities: Individual AFV. Dismounted infantry in section to fireteam size entities. Temporary detachments down to individual men. Movement (including obstacles), line of sight, detection (including obscuration), direct fire, indirect fire and house clearance are represented.

CONSTRUCTION:
Human Participation: Players must make all action decisions at entity level by means of verbal orders to game controllers using workstations. Controller input is required to moderate game pace to suit the training objectives of individual player groups.

Time Processing: Dynamic, event-step methodology at one second resolution. Certain battle processes (e.g., movement) are assessed in short time cycles.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: Two-sided, symmetric.

LIMITATIONS: Currently restricted to village type build-up terrain (i.e., small, detached buildings).

PLANNED IMPROVEMENTS AND MODIFICATIONS: None currently funded.

INPUT: Force structure, weapons and ammunition allocations. Starting positions and movement plans. Defensive preparations.

OUTPUT: Hardcopy battle feedback to players by multiple printers, each allocated to a specific (user determined) grouping of forces. Printed feedback also used to update optional battle maps and 3D terrain boards. Graphical battle state and progress displays available to game controllers.

HARDWARE AND SOFTWARE:

Computer:	Thin Ethernet network of 3 PC compatible microcomputers. Non-dedicated server (25 MHz 80386 or better, 8 Mb RAM, VGA, mouse). Two workstations (16 MHz 80286 or better, 4 Mb RAM, VGA, mouse). Uses OS/2 and OS/2 Lan Manager.
Storage:	Server min. 40MB, of which 2 Mb required for system files and up to 10 Mb for archives created during game play. Workstations min. 20 Mb.
Peripherals:	Current operational setup comprises 1 x 132 column printer, 6 x 80 column printers, 1 x 8 port peripheral controller (directs printed output from main computer to 7 printers under software control).
Language:	PASCAL.
Documentation:	Overview and (minimal) User Guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Up to one hour to prepare a new force structure and enter initial battle deployments and plans.

CPU time per Cycle: Maximum simulation speed (with no orders input) approx. 1 simulated minute per 3-5 minutes of real time (battalion versus company).

Data Output Analysis: N/A.

Frequency of Use: Approximately one main game per month, subject to variation within normal army training regime.

Users: British Army FIBUA training Team.

Comments: None.

TITLE: UVWR - Ultraviolet Warning Receiver Detection Range Program.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The UVWR Detection Range program is a computer program which calculates the detection range of a warning receiver operating in the ultraviolet (UV) spectral region. The program can also be used to determine the detection range of a UVWR operating from an aircraft at a user specified altitude.

DESCRIPTION: The basic function of the UVWR program is to determine the range at which a source (target) can be detected by UVWR operating in a particular meteorological environment. The UV detection range is the maximum range (between the source and the receiver) at which detection can occur.

The UV detection range is determined using the method of bisection to solve the detection range equation. First, a check is made to determine if detection is possible. If detection is possible, an iteration on target to warning receiver angle is performed until the detection range matches the geometric range between the target and warning receiver.

INPUT: System parameters such as detector area, quantum efficiency, and filter characteristics are user input. The UV solar background count can be user input or calculated by the model. The UV radiation from the target source may be characterized as a blackbody or by input values of the spectral radiant intensity. Meteorological condition options are also set by the user. One combination of the following atmospheric and haze models (the model atmosphere and haze data are contained in the LOWTRAN 6 program) must be selected:

Model Atmospheres	Haze Models
Tropical	Rural
Midlatitude Summer	Maritime
Midlatitude Winter	Urban
Subarctic Winter	Tropospheric
Subarctic Summer	Advection Fog
1962 U.S. Standard Atmosphere	Radiation Fog

In addition, the user must specify the sea level visual range (visibility) and may specify the total ozone concentration, surface reflectivity, and the height of the reflecting surface above ground level.

OUTPUT: The program output consists of a summary of the input data followed by the UVWR detection ranges (KM) versus the solar zenith angle. The total ozone concentration is also printed if the LOWTRAN Model value is used.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	189,952 bytes.
Language:	FORTRAN 77.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Source code is unclassified.

GENERAL DATA:

Time Requirements: Compilation time: 10.1 seconds; Typical run time: 12.3 seconds.

Users:

AFEWC/SAT
ASD/ENSSS
ASD/XRHD
BDM Corporation
Ball - Systems Engineering Division
Battelle Memorial Institute - Columbus Division
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
Daimo Victor Inc., The Singer Company
E-Systems, Greenville Division
General Dynamics Corporation
General Dynamics/Convair Division
General Research Corporation
Hughes Radar Systems
Logicon, Inc.
Loral Advanced Projects
Loral Electronic Systems
McDonnell Aircraft Company
Merit Technology Inc.
Mitre Corporation
NASA Lewis Research Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Defense Systems Division
OptiMetrics, Inc.
SAIC
TRW/Military Electronics & Avionics Division
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
W J Schafer Associates
Westinghouse Electric Corporation.

TITLE: VADSS - Victory Corps 2000 Automated Decision Support System.

DATE IMPLEMENTED: 1 January 1991.

MODEL TYPE: Analysis - Operation Support Tool (Decision Aid).

PROPONENT: V Corps, ATTN: AETV-OR, APO NY 09079-0700, Frankfurt, Germany.

POINT OF CONTACT: Mr. Tom Knopp & Mr Larry Tolin, AV 320-7591/6364, Commercial 001-49-69-151-7591/6364.

PURPOSE: The model was developed to provide insights regarding installation closures in the V Corps area in the Army build-down environment. The program allows users to rapidly evaluate the ability of alternative residual installation sets to provide services to alternative residual Army unit sets from a variety of management perspectives. The program is used by V Corps headquarters and subordinate commanders to investigate stationing and force change options and determine impacts on quality of life (QOL) programs. The initial phase includes 16 QOL programs (paragraph 2, page 3, attached User's Manual) and permits simultaneous, dynamic analysis at the corps, region, military community, and installation levels. The model is being expanded to include the European theater and hardstand and maintenance facilities (essential for stationing analyses of relocating troops and associated equipment), equipment, and training areas. A personnel module will be added in 1992.

DESCRIPTION:

Domain: Land installations in the V Corps zone of Germany.

Span: Currently 242 installations. The model is being expanded to include all USAREUR theater installations (approximately 64? installations in five countries).

Environment: PC based - models troop movements, activations, deactivations, deployments/ redeployments, and their impacts on installations and communities affected.

Force Composition: Army soldiers in the V Corps area, and DOD dependents and all Army units assigned to the V Corps area.

Scope of Conflict: The program design provides a dynamic "what-if" analysis capability to compare numerous alternative stationing configurations and its impact on QOL programs. The graphical output allows decision makers to see the impact of various possible actions, all expressed relative to capacity of soldiers supported. Build-down of units, full and partial closure of installations, addition and removal of selected resources (QOLs), activation/deactivations of any size unit, deployment/redeployment of units (intra and inter corps), move units, and move populations are possible actions.

Mission Area: DEH, DPCA, DOL, DPTMS, DOIM, stationing.

Level of Detail of Processes and Entities: The program provides demographic and facility data at the corps, region, military community, installation, and unit levels for the following items:

QOL PROGRAMS:

Family Housing
Barracks
Dining Facilities
Gymnasiums
Medical
Dental
Child Development
DODD Schools
Commissaries
Main PXs
Branch PXs

DEMOGRAPHICS:

Commissary patrons (mil/civ/dep)
Dental patients (mil)
Main PX patrons (mil/civ/dep)
Branch PX patrons (mil/civ/dep)
Family members (military)
Family members without passports
Household goods shipments
House pets
Housing (all sponsors needing quarters)
Medical exceptional family member program (EFMP) patients
Medical family assistance program patients
Physical fitness centers (gymnasium) users (mil/civ/dep)
School children CDC age 0-4
School children elem age (K-6)
School children mid age (7-8)
School children high age (9-12)
School children elem EFMP
School children mid EFMP
School children high EFMP
Soldiers, joint domicile
Soldiers to mess (E1-E6)
Soldiers, unaccompanied needing barracks (E1-E9)
Soldiers, unaccompanied
Spouses, foreign
Spouses, military
Spouses, pregnant
Spouses, working
Total automobiles
Total DACs and NAFs
Total DPP/loans
Total legal actions pending
Total personnel: mil/civ/dep
Total private rentals
Total private weapons

FACILITIES:

Child Development Centers
All structures under DODDS supervision
All structures under AAFES supervision
All structures under TSA EUCOM supervision
All structures under Medical supervision
All structures under Dental supervision
All UPH (barracks), family housing, BEQ, BOQ structures
All dining facilities and fitness centers (gymnasiums)

FACILITY DATA:

Type construction
Ownership
Condition
Year acquired
Disposition
Gross area
Net area
Cost to government
Non-appropriated cost
Appropriated improvement cost
Maintenance cost
Rental cost
Utility cost

CONSTRUCTION:
Human Participation: Users must select actions for units and installations. The program is extremely user friendly and totally menu driven. All data and algorithms are transparent to the user. The user can modify factors, as all values are in tables, not hard-wired into the programming code. On-screen context-sensitive help is available at any point in the program.

Time Processing: Static.

Treatment of Randomness: Basically Deterministic.

Sidedness: N/A.

LIMITATIONS: The program contains only 16 of 84 QOL programs and includes the installations and units of V Corps as it was organized prior to Desert Shield and Desert Storm and the USAREUR 15 June 1991 realignment of command and control lines. The model will allow dynamic realignment to any command configuration.

PLANNED IMPROVEMENTS AND MODIFICATIONS:

Equipment Module (separate menu item): This module will assist staff personnel to make recommendations regarding equitable distribution of key equipments. This module will allow the user to cross-level equipments (Pacing items; ERCs A, B, & C), assign residue equipments from draw-down or inactivated units, and assign new equipment in an optimum manner (this module will be classified).

Expansion to Theater Level (existing program): The program will include all USAREUR units and installations to be flexible enough to perform analyses in the dynamic environment of the 1990s.

Realignment Module (existing program): This module will allow users to dynamically affiliate any unit or groups of units at any level of organization with any others.

Maintenance and Hard Stand Module (existing program): This module will allow user to compare the availability (capacity) of maintenance and hardstand space to the demand placed by soldiers and associated equipment of various type units.

Training Module (separate menu item): This module will assist staff and managerial personnel to perform "what if" analyses to determine which training areas must be kept and which training areas may be released to the host nation and still be able to meet the training needs of the residual forces in Germany. The module will also allow users to compare capacity to demand for LTAs and MTAs and will provide a data source for planning, allocating (scheduling), and enhancing training areas.

Personnel Module (separate menu item): This module will assist staff personnel to make recommendations regarding cross-leveling of personnel in critical MOSs.

Graph Options Module (existing program): This module will allow users to select the type(s) of output graphs - 2D/3D, bar, line, area, pie, cluster, stacked; and to select the organization level.

OUTPUT: The output is in the form of paired bar graphs, comparing demand (numbers of soldiers) and supply (capacity in terms of soldiers); and summaries providing a record of actions taken that result in each graph. The user can compare the graphs of several alternatives to determine which provides the better ability to accommodate the needs of soldiers.

HARDWARE AND SOFTWARE:

Computer: Designed to run on an IBM-compatible PC with 512K Random Access Memory (640K recommended) running on MS-DOS 2.2 or later version.

Storage: A minimum of three Mbytes of hard disk space.

Peripherals: EGA (preferable color) monitor and Printer (optional).

Languages: The program establishes new analytical techniques in that it incorporates several off-the-shelf language specific libraries which are all transparent to the user.

Clipper 5.1	Compiler
C	Compiler
Funcky	Library
Flipper 5.0	Graphics Library
DGE 4.0	Graphics Library
PC Paint Brush IV	Paint Program
Dan Bricklens Demo3	Prototype Tools
Say What?	Screen Painter
Look & Feel with Cscape	Screen Painter
DBase IV	Data base

SECURITY CLASSIFICATION: Unclassified (the equipment module will be classified when completed in August 1991 due to its use of the REQVAL data base).

GENERAL DATA:

Data Base: The program uses existing USAREUR and HQDA data bases, eliminating the requirement to gather data, facilitating periodic updating, standardizing to be consistent with other staff actions, and reducing the GIGO syndrome.

Headquarters Installation Facilities Support - Europe (HQ-IFS (U)).
Requirements Validation (REQVAL).
SIDPERS.
VTADDS.

CPU time per Cycle: N/A.

Data Output Analysis: The system provides quantitative and qualitative information regarding QOLs and demographics, obtained from several USAREUR and Army data bases, and displays the information tabularly and graphically. The graphical output (figure 1) allows decision makers to see the impact of various possible actions. The system design provides a dynamic "what-if" analysis capability to compare numerous alternative stationing configurations.

Frequency of Use: Varies by command and staff position. VADSS has been used to validate HQDA and USAREUR CFE stationing decisions at the USAREUR and Corps levels and has been used as an expeditious and convenient data source by numerous staff sections at the USAREUR and Corps levels. When the follow-on equipment module is completed in August 1991, it will be used by 3d COSCOM, CMMC, and corps and USAREUR logistics personnel to assist in cross-leveling and residual equipment transfer decisions. Due to the strong acceptance of the program, the immediate follow-on work will be to expand the program to theater level. The training module will be completed by December 1991 and will be used to evaluate which training areas should be retained and which should be returned to the host nation.

Users: USAREUR, Corps, MILCOM, installation staffs: Department of Engineering and Housing; Department of Logistics; Department of Plans, Training, Mobilization, and Security; Department of Personnel, C, and A; Department of Information Management.

Comments: In February 1991 the USAREUR D~~SIM nominated VADSS as their candidate for a Department of the Army Installation Support Module. This module should be strongly considered for expansion to joint (EUCOM) use, as duplication Army and Air Force facilities can no longer be afforded under extremely constrained budgetary conditions.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: VAST - Vulnerability Analysis for Surface Targets.

DATE IMPLEMENTED: 1978.

MODEL TYPE: Analysis.

PROPONENT: Ballistic Research Laboratory, Aberdeen Proving Ground, MD 21005-5066.

POINT OF CONTACT: L. D. Losie, (301) 272-6979, AV 298-6979.

PURPOSE: VAST is a component-level point burst methodology that is used to estimate the vulnerability of a surface target to a hit either by a shaped charge jet or by fragmentation from artillery. VAST is an expected value model that infers the vulnerability of a target from the cumulative effects of calculated component damage, which degrades the tactical functions of such an inflicted ground armored vehicle.

DESCRIPTION:
Domain: Abstract.

Span: N/A.

Environment: N/A.

Force Composition: N/A.

Scope of Conflict: N/A.

Mission Area: N/A.

Level of Detail of Processes and Entities: N/A.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: N/A.

Treatment of Randomness: N/A.

Sidedness: N/A.

LIMITATIONS: VAST models damage mechanisms of penetration and spall, but does not model the effect of other damage mechanisms, such as ricochet, secondary spall formation or hydraulic ram, on components.

PLANNED IMPROVEMENTS AND MODIFICATIONS: No improvements or modifications are currently planned.

INPUT: VAST requires a variety of input data that includes a table defining each component of the surface target, a table of component conditional probabilities of kill, data describing an attacking munition, a rule book for converting component loss into tactical degradations of vehicular functions, and files containing geometric information on the armored vehicle.

OUTPUT: For fragments from an artillery shell, VAST produces tables of vulnerable areas for individual components and for the target. For a shaped charge jet, VAST produces target probability of kill estimates.

HARDWARE AND SOFTWARE:

<u>Computer</u>: Currently runs on a CRAY XM-P under a UNICOS operating system.

<u>Storage</u>: VAST requires 300K words of memory for program execution. Memory requirement for a typical geometry file is 5000K words.

<u>Peripherals</u>: One VT100 terminal or similar equipment and one printer.

<u>Language</u>: FORTRAN.

<u>Documentation</u>: Two contractor reports and one government report.

SECURITY CLASSIFICATION: The code is unclassified, but some of the inputs could be classified.

GENERAL DATA:

<u>Data Base</u>: No data base per se, but preparing inputs can take as long as one year.

<u>CPU time per Cycle</u>: Execution time depends upon the combination of surface target and attacking threat. A detailed analysis may require one hour of CPU time.

<u>Data Output Analysis</u>: Postprocessor aids in output analysis.

<u>Frequency of Use</u>: VAST is used several times per year.

<u>Users</u>: Ballistic Research Laboratory.

<u>Comments</u>: None.

TITLE: VECTOR-3.

DATE IMPLEMENTED: 1982.

MODEL TYPE: Analysis.

PROPONENT: Vector Research, Incorporated, PO Box 1506, Ann Arbor, MI 48106.

POINT OF CONTACT: George Miller, (313) 973-9210.

PURPOSE: VECTOR-3 is a research and evaluation tool which deals with force capability and requirements (i.e., R&D planning, systems acquisition, and force structure issues), as well as combat development (doctrinal issues).

DESCRIPTION:

Domain: Land and air.

Span: Can vary from division to theater.

Environment: Terrain cells (typical size, 4x7 km.) distinguish differences in battlefield trafficability and intervisibility. Natural and man-made barriers can be played. A transportation network is also represented. Weather conditions, which are uniform throughout the battlefield and are updated each hour, can affect both trafficability and visibility for air and ground operations.

Force Composition: Joint and combined forces, Blue and Red.

Scope of Conflict: Conventional warfare.

Mission Area: All conventional AirLand mission areas.

Level of Detail of Processes and Entities: Unit resolution is user specified (e.g., battalion maneuver unit resolution for a corps-level scenario). In tactical air operations, resolution is to user-specified individual flight group (typically two to four aircraft). For air transport operations, the group size is one aircraft; i.e., each sortie is individually simulated. In most process modeling, the level of system resolution is the individual system type in the unit.

CONSTRUCTION:

Human Participation: Not required; scheduled changes are allowed.

Time Processing: Dynamic, time- and event-stepped. Eight nested clocks are used to reduce execution time while allowing status to be updated at appropriate frequencies.

Treatment of Randomness: Deterministic; generates a value as a function of an expected value.

Sidedness: Two-sided, symmetric.

LIMITATIONS: No naval warfare; no chemical, biological, or nuclear warfare.

PLANNED IMPROVEMENTS AND MODIFICATIONS: No specific improvements are currently planned, but the model is regularly modified to add capabilities required to support new applications.

INPUT: 1) System performance capabilities; 2) initial force and supply inventory and organizational data, and a schedule of unit and resource arrivals; 3) data describing the environment; 4) tactical decision rules; and 5) initial intelligence information.

OUTPUT: The total trajectory of all important statuses (missions and activities, force inventories and attrition, unit locations and movement, supply deliveries and consumption, etc.) during a campaign are stored by the model for later summary and display by postprocessors.

HARDWARE AND SOFTWARE:

Computer:	Most applications have been conducted on an IBM mainframe computer using the Michigan Terminal System (MTS) operating system. The model also is run on a Concurrent minicomputer and a SUN workstation.
Storage:	Approximately 2.6 million bytes.
Peripherals:	No special peripherals are required.
Language:	Transportable FORTRAN.
Documentation:	Only summary documentation and online program documentation exist.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Data modifications to an existing scenario for a new study typically require one to a few person months of effort, depending on the extent of the changes. Development of an entirely new scenario can require up to a person year.

CPU time per Cycle: Typical execution time on the mainframe computer is approximately 1.5 CPU minutes per simulated day of corps-level combat, including postprocessing of results.

Data Output Analysis: Approximately one person week of effort is required for a thorough analysis of the results of a several-day, corps-level run.

Frequency of Use: Several studies per year.

Users: VRI has used VECTOR-3 for the U.S. Army (DCSOPS, TRADOC, AMC) the U.S. Air Force (ASD), and for defense industry.

Comments: VECTOR-3 is one of the latest in the VECTOR series of models. An earlier version, VECTOR-2, has been used by various Army agencies within TRADOC and AMC as well as by the SHAPE Technical Center and several defense industrial contractors. The Army's corps-level model VIC is based in part on VECTOR-2 and thus has many similarities to VECTOR-3.

TITLE: VEDER - Visual/Electro-Optical Detection Range Model.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT:

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: VEDER is a computer program which determines the horizontal Visual/Electro-Optical (EO) detection range of targets such as aircraft and/or cruise missiles with known geometric areas and inherent contrast. The program determines the visual detection range of an EO sensor searching for a target flying at a specified altitude and speed. VEDER is a functional model developed primarily to provide input to the AADEM model.

DESCRIPTION: The basic function of the VEDER program is to determine the visual detection ranges of specific visual/EO sensors attempting to acquire a target aircraft (with a known inherent contrast) flying at a given altitude in a particular meteorological environment. In addition, it determines a set of scaling law parameters by minimizing the difference between the detection range determined by the SEARCH model. Since the minimization procedure finds a local minimum, which, in general, may depend on the initial values of the scaling parameters, an interactive procedure is available in the program to allow the user to vary the initial values of these parameters.

The horizontal detection range is defined as the ground range from the aircraft to the observer at the time when the cumulative probability of detection reaches a user-defined threshold value.

The number of azimuth angles for which the visual detection range is calculated is user-defined. The range of detection angles will vary from 0 degrees to one half of the defined search field azimuth plus one half the observer field-of-view; i.e., it is assumed that the search field limits apply to the center of the observer's field-of-view.

INPUT: The user must enter the geometric areas describing the target, the target's altitude and flight speed, the parameters which specify the characteristics of the visual search field and the optics, the target's inherent contrast, and the surface level visibility.

OUTPUT: The program output consists of a summary of the input data followed by the horizontal visual/EO detection ranges displayed at various azimuthal angles relative to the aircraft, the scaling law parameters, and the relative errors in the scaling law.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780.
- Storage: 136,192 bytes.
- Language: FORTRAN 77.
- Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:

Time Requirements: Compilation time: 9.9 seconds; Typical run time: 131 seconds.

Users: BDM Corporation; E-Systems, Greenville Division; Georgia Institute of Technology; Hughes Radar Systems; Mitre Corporation; SAIC; U.S. Army SMO, SLCSM-AT; United Technologies; WL/AAWW-3.

TITLE: VEHW - Vehicle Weathering Model.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis.

PROPONENT: CRDEC, Studies & Analysis Office, Aberdeen Proving Ground, MD 21010-5423.

POINT OF CONTACT: Mr. Richard zum Brunnen, (301) 671-3570, AV 584-3570.

PURPOSE: VEHW is used to predict liquid agent persistence and vapor emission of chemical agent droplets on a moving vehicle. It is designed to estimate liquid contamination levels on the various surfaces of a vehicle as a function of wind flow patterns, temperature, and time.

DESCRIPTION:
Domain: Land.

Span: Vehicle contamination within a targeted area or sector.

Environment: Flat, open terrain with steady-state meteorology.

Force Composition: BLUE or RED vehicles.

Scope of Conflict: Chemical warfare.

Mission Area: Chemical combat missions.

Level of Detail of Processes and Entities: The model uses the CRC methodology to consider evaporative and absorptive properties.

CONSTRUCTION:
Human Participation: Not permitted after inputs have been set up and program executes.

Time Processing: Agent weathering determined by the amount of vehicle surface contamination levels remaining as a function of time.

Treatment of Randomness: Deterministic.

Sidedness: Not applicable, because VEHW is an equipment evaluation model, not a war game.

LIMITATIONS: Methodology considers a moving vehicle with agent being picked up from contaminated terrain. It does not consider cracks, crevices, dirty vehicle surfaces, or solar loading effects, but considers only painted surfaces with steady-state meteorology. Model has not been validated.

PLANNED IMPROVEMENTS AND MODIFICATIONS: No plans for further improvements and testing exist.

INPUT: Input requirements are the following: vehicle size and geometry, ground contamination levels, droplet sizes, windspeed and angle, vehicle speed and location, distribution of vehicle temperatures, surface type, and desorption rate versus time data.

OUTPUT: Amount of agent desorbed and absorbed, amount of agent remaining as a function of time, and evaporative and desorptive flux from various vehicle surfaces.

HARDWARE AND SOFTWARE:

Computer:	Runs on the UNIVAC 1100/60 computer system.
Storage:	Approximately 2500 lines of code.
Peripherals:	Minimum requirement: one printer.
Language:	ASCII Standard FORTRAN 77.
Documentation:	Published report available.

SECURITY CLASSIFICATION: Unclassified program.

GENERAL DATA:

Data Base: Time for preparation of the data base of input values basically depends on the availability of vehicle information. Once the vehicle characteristics are available, it takes very little time (less than 15 minutes) to input the values and run the program.

CPU time per Cycle: Less than one minute.

Data Analysis Output: Postprocessing is not necessary for analysis of the output results.

Frequency of Use: Several times per year.

Users: CRDEC and contractors.

Comments: CRDEC is responsible for configuration control of model and consistency of output results.

TITLE: VGCUFS - Vehicle Gap Crossing Under Fire Simulation.

DATE IMPLEMENTED: 1985.

MODEL TYPE: Analysis (weapon and vehicle performance simulation).

PROPONENT: U.S. Army Materiel Systems Analysis Activity (USAMSAA), Aberdeen Proving Ground, MD 21005-5071.

POINT OF CONTACT: Mr. L. Martin (301) 278-6437, DSN 298-6437.

PURPOSE: VGCUFS can assess the effect of a vehicle's automotive performance or changes in vehicle parameters such as engine performance or weight on its ability to survive on the battlefield. The effect of specific terrain on the target vehicle-weapon encounter can also be examined.

DESCRIPTION:
Domain: Land.

Span: Local. Generally, participants are separated by 10,000 meters or less and separation may close depending on the path traveled by the target.

Environment: Target vehicle travels cross country over dry terrain. Threat weapon is stationary. Intervisibility varies depending on terrain being simulated.

Force Composition: One-on-one simulation: a target vehicle and a threat weapon.

Scope of Conflict: Conventional weapons, primarily direct-fire, vehicle-mounted systems.

Mission Area: Encounters between surface vehicles.

Level of Detail of Processes and Entities: Vehicle automotive performance is modeled in detail. Changes in engine power output, transmission, differential, tires or tracks, vehicle weight, center of gravity location, or suspension performance may affect model output since they affect vehicle cross country performance. The user can choose either statistical or analytical terrain representation. If statistical terrain representation is chosen the terrain is defined by soil type and strength, surface slope, and "in view" and "out of view" segment lengths. These segment lengths are developed by making random draws on statistical distributions for the specific terrain being simulated. If analytic terrain representation is chosen by the user then terrain is described by surface type, strength, and slope, obstacle size and distribution, and vegetation size and distribution. Intervisibility is computed using digitized elevation data which correspond to the area being simulated, line of sight existence is calculated based on the user chosen weapon site, target vehicle path, and the configuration of terrain between the weapon site and the target path. The target profile presented to the weapon is a two rectangle fit. The threat weapon is simulated using accepted methodology fed by horizontal and vertical bias and dispersion data as a function of range to target, speed of target, and angle of approach of target.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Dynamic, time-step.

Treatment of Randomness: Limited to simulation of terrain characteristics obtained by stochastic draws on the appropriate distributions.

Sidedness: Two-sided, asymmetric; one side is nonreactive.

LIMITATIONS: One weapon firing at one target that does not return fire.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Ability of the target vehicle to maneuver and return fire are planned improvements.

INPUT: Target vehicle data required includes weight, center of gravity location, vehicle geometry, and powertrain and suspension characteristics. Weapon data required are horizontal and vertical bias and dispersion as a function of range and target speed, time to first shot, and time to subsequent shots. The target vehicle is described by a two rectangle fit at the angle of attack being simulated. If a statistical representation of terrain is chosen by the user then data required are mean "in view" segment length, mean "out of view" segment length, and mean first opening range. If analytic representation of terrain is chosen by the user then a digitized elevation file of the map sheet being simulated is required.

OUTPUT: Graphs and tables give probability of each shot hitting the vehicle and elapsed time, distance traveled, range, and vehicle speed at shot time. Probability that the vehicle can cross the "in view" segments and not be hit is tabulated. Three dimensional graphic views of the vehicle path and shots taken allow the user to view the scenario as simulated by the model.

HARDWARE AND SOFTWARE:

Computer:	Cray-XMP, UNIX operating system.
Storage:	Main Program - 91594 bytes, pre and postprocessor - 26300 bytes.
Peripherals:	1 printer, 1 color graphics copier.
Language:	FORTRAN
Documentation:	Documented as "AMSAA Combat Support Division Interim Note No. C-151" (does not include documentation of statistical and analytical treatment of terrain).

SECURITY CLASSIFICATION: Unclassified but weapon and vehicle data is often classified.

GENERAL DATA:

Data Base: Many weapons and vehicles now reside in the data base. New data can be transcribed in a matter of hours, if available. If data is not available, then testing must be done.

CPU time per Cycle: For one replication of the model running one vehicle: 1.94 seconds.

Data Output Analysis: Postprocessors analyze, condense, plot, and tabulate program output.

Frequency of Use: Extremely variable.

Users: USAMSAA

Comments: N/A.

TITLE: VIC - Vector In Commander.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: TRAC-WSMR, White Sands Missile Range, NM 88002-5502.

POINT OF CONTACT: Mr. Dick Porter or Mrs. Lynda Tonus, (505) 678-1901, AV 258-1901.

PURPOSE: VIC is a computerized, analytical, mid-intensity model developed for use in estimating net assessments, performing force deployment studies, and generating information for performing trade-offs among weapon systems. The outcome of force interactions is determined in terms of the ground gained or lost and the attrition of personnel and weapon systems.

DESCRIPTION:
Domain: Land, air, and space (overhead to land).

Span: Accommodates any theater depending on data base.

Environment: Grid square; representation contains trafficability and intervisibility information.

Force Composition: Joint and combined forces.

Scope of Conflict: Conflict other than strategic nuclear, corps-level, or lower-level conventional conflict.

Mission Area: All conventional missions.

Level of Detail of Processes and Entities: The level of aggregation is the maneuver battalion or its equivalent. It employs forces up to the level of a U.S. corps facing an enemy of strength determined by the scenario and theater in which the simulation takes place. It uses modified differential equations for combat outcomes based upon the VECTOR-2 model. Tactics are supplied by the user to provide flexibility in controlling model processes. Each side may employ maneuver units, weapon systems, and weapons of tactical aircraft, as well as artillery, mines, helicopters, air defense systems, and other means of conducting combat at the U.S. corps level.

CONSTRUCTION:
Human Participation: Required for decisions and processes.

Time Processing: Dynamic, time- and event-step.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided.

LIMITATIONS: Currently no nuclear or directed energy weapons portrayal; both under development.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Improvements are planned for nuclear and chemical functional areas and for modeling new weapon systems.

INPUT: Forces and supply inventories, basic weapons performance data, other system performance data, geographic and terrain data, and tactical decision tables.

OUTPUT: Casualties and system losses (killer/victim scoreboards, etc.), FLOT traces and force positions over time, target acquisition and intelligence summaries, availability and condition of forces and supplies, and air battle and air defense results.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	Minimum required: 800,000 blocks.
Peripherals:	CRT, high-speed printer.
Language:	SIMSCRIPT and FORTRAN.
Documentation:	N/A.

SECURITY CLASSIFICATION: Data bases are often classified.

GENERAL DATA:

Data Base: N/A.

CPU time per Cycle: Depends on data base size; can take hours of CPU time to process hours of battle.

Data Analysis Output: Postprocessor aids in analysis output, raw data, graphics display, and time periods.

Frequency of Use: Continuous.

Users: VIC Model Users Group, TRAC.

Comments: Studies agencies and study applications for which the model has been used: AFV, DEEP FIRES, BF90, FAADS, LHX, CAMAA.

TITLE: VIRGO - VAX Infrared General Optimization.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-6543; (513) 255-4429.

PURPOSE: The VAX Infrared General Optimization (VIRGO) Engagement Simulation Program simulates the engagement between a single Infrared (IR) seeking missile and a single target aircraft. IR flare and target signature suppression countermeasures used by the target aircraft are simulated to determine their effect on the miss distance. VIRGO models the flight path of the target aircraft, the missile dynamics and trajectory, and the countermeasure effects on the missile's trajectory.

DESCRIPTION: The program simulates the engagement of both air-to-air and surface-to-air IR-homing missiles versus either single engine or multiple engine aircraft. The countermeasures which the target aircraft can deploy are either IR flares (pyrotechnic or pyrophoric) or a combination of flares and an absorptive signature suppression countermeasure such as carbon black.

The model is a time-stepped program which reads user controlled inputs from a disk file. It also reads missile, flare, and aircraft data from disk files. The program operates in a single phase with a single input deck.

INPUT: The user has a choice of inputs for VIRGO. The user may select a predetermined set of missile, target, and flare characteristics, or set up disk file which defines the characteristics of the desired missile, target, or flare.

OUTPUT: The program outputs provide the user with the information needed to evaluate the results of the simulation. These output files are described below.

Normal Output: This output is generated for every run. The normal output is a data file which contains a listing of all the missile, target aircraft, and flare characteristics which were read in upon execution of the program. At the end of the file are printed the number of one-on-one engagements in which the missile's closest approach to the aircraft was greater than miss (a user input value).

Optional Output: There are a variety of files which the program will generate upon request by the user. The user may generate output files that list parameters used to simulate the engagements such as a listing of the target aircraft's IR signature, or the flare's static burn profile. To help interpret the results of the engagements the user may request files listing the miss distance of each one-on-one engagement, the missile trajectory, the target aircraft trajectory, the flare trajectory, or the irradiance of each aircraft engine and its angular location within the missiles FOV. If there are several one-on-one engagements simulated for a program execution, the trajectory and engine irradiance es are for the first engagement only.

HARDWARE AND SOFTWARE:

Computer:	VAX 11/780.
Storage:	276,480 bytes.
Language:	FORTRAN 77.
Documentation:	User's Manual.

SECURITY CLASSIFICATION: Source Code is unclassified.

GENERAL DATA:

Time Requirements: Compilation time: 201 seconds; Typical run time: 6 seconds.

Users:

AFCSA/SASB
AFEWC/SAM
AFEWC/SAT
ASD/ENAMA
ASDI
BDM Corporation
Ball - Systems Engineering Division
Boeing Advanced Systems
Boeing Aerospace
Booz, Allen & Hamilton
Brunswick Defense (AMTC)
Calspan Corporation
General Dynamics / Convair Division
General Electric Aircraft Engines
Hughes Radar Systems
IBM
Lockheed Aircraft Services Company
Logicon, Inc.
Loral Advanced Projects
Mission Research Corporation
NASA Lewis Research Center
Naval Air Propulsion Center
Naval Weapons Center
Naval Weapons Support Center
Northrop Defense Systems Division
OptiMetrics, Inc.
SAIC
Sanders Associates, Inc.
Sverdrup Technology, Inc.
The Rand Corporation
Tracor Aerospace, Inc.
USAF ESD/ICZ
United Technologies
WL/AAWW-3.

TITLE: Visible, Near, Mid and Far IR Transducer.

DATE IMPLEMENTED: Near IR system is in production since January 1988.

MODEL TYPE: Device projects real or simulated IR image.

POINT OF CONTACT: Jerry Rusche, DSN 354-2730; Comm (703) 664-5065.

PURPOSE: Output provides real or modeled IR scene simulation as input to night vision image intensifiers, thermal imagers and IR seekers. Simulation can be used to evaluate performance tradeoffs in image intensifiers, thermal imagers and seeker devices. Simulation can also be used for training and TMDE (Test Measurement and Diagnostic Equipment.)

DESCRIPTION:

Domain: Covers spectral range 0.7 to 12 microns. Can be used in any air, land and sea scenario requiring spectral simulation.

Span: Provides simulated and modeled signals to image intensifiers, thermal imagers and seeker devices. The device can accommodate any theater, depending on the data base.

Environment: Television (analog or digital).

Force Composition: As desired, depending on data base.

Scope of Conflict: As desired, depending on data base.

Mission Area: Any mission requiring use of night vision or IR seeker sensors.

Level of Detail or Processes and Entities: Device projects IR image. The level of detail fed into the IR projector is chosen by the user and can be in either analog or digital format.

CONSTRUCTION:

Human Participation: Imagery can be used directly by: IR seeker; IR imager-automatic target recognize system; IR imager-human system.

Time Processing: Projected images are dynamic real time. They are currently projected at a 30 frame/sec rate. Research indicates that 4000 frames per second may be possible.

Treatment of Randomness: Currently pre-recorded or live scenarios are used. The device may be made interactive if desired. Scene input can be random. Output of device is a deterministic with output spectral band chosen by user.

LIMITATIONS: Frame rate is currently limited to 30 frames/sec. Spectral range is currently limited to between 0.7 and 12 microns. Usage of device is limited by imagination and resources of user.

PLANNED IMPROVEMENTS AND MODIFICATIONS: This is an ongoing R&D program. Current research is oriented to improving spatial resolution, frame rate, grey level fidelity, etc.

INPUT: Input is a digital or analog simulated image or an image collected by a sensor.

OUTPUT: Output is an image in the spectral range between 0.7 and 12 microns chosen by the observer.

HARDWARE AND SOFTWARE:

Computer(OS): Selected by user.

Storage: Input imagery is stored on any conventional image storage media.

Peripherals: Digital imaging television devices and thermal sensors as selected by the user.

Language: Chosen by user.

Documentation: Limited documentation available.

SECURITY CLASSIFICATION: Device is unclassified. Device could use classified imagery.

TITLE: Visual Search.

DATE IMPLEMENTED: 1980.

MODEL TYPE: Analysis.

PROPONENT: WL/AAWA-1 Analysis & Evaluation Branch Electronic Warfare Div.

POINT OF CONTACT: William K. McQuay, WL/AAWA-1, Bldg. 620, Area B, WPAFB, OH 45433-654; (513) 255-4429.

PURPOSE: The purpose of the SEARCH model is to predict the ability of one or more observers to detect an airborne target, typically an aircraft, via visual search. A running cumulative probability of detection as a function of time is computed for each target/observer engagement and this cumulative detection probability versus time is the model output.

DESCRIPTION: Two distinct tactical modes are available within the model, "search" and "stare." In the search mode, the direction of the target is unknown, and search takes place over a solid angle sector with specific azimuth and elevation dimensions. The "stare" mode is used when good directional information regarding the aircraft is available to the searcher; e.g., when telescopes or TVs are radar directed toward the target. The stare mode should not be used with the unaided eye.

After some initialization, SEARCH sets up the optical path from the target to the observer(s) through the atmosphere. It then assigns positions to the sun, to the target, and if necessary, to the observer(s) to calculate the sun-target/observer-target phase angle.

SEARCH then calculates the target's inherent contrast to determine apparent contrast. The single glimpse detection probability uses the ratio of target contrast to the threshold contrast of the target. The threshold contrast of a target is the contrast at which the detection probability for a single glimpse assumes some nominal value. The latest single glimpse probability is combined with previous ones to develop a cumulative probability.

A single engagement for which the cumulative probability of detection is computed consists of one or more observers at the origin of a rectangular coordinate system, and a target starting at specified coordinates relative to the observer(s). The target moves with a given speed in a straight and level flight path. Calculation continues until a user-specified target position value is reached. During this target motion, the detection probability is computed every 1/3 second. The final output is the cumulative probability of detection printed for every second of the engagement.

When there is more than one observer, search by each is taken to be independent. When more than one observer is searching, the cumulative probability of detection is interpreted as the probability that the target is being seen by at least one observer.

The properties of the penetrator target to be input to the model are the target size and contrast against the sky as presented to the searching observer(s). The program models all targets as diffuse, reflecting spheres whose size varies as would the projected area of the target. The program computes the angular diameter of an equivalent sphere based upon the target slant range, aspect, and inputs describing target size as seen from the front, side, and bottom.

SEARCH offers the option of assuming a fixed inherent target contrast, bypassing all calculations dealing with illumination and background, or the model can compute inherent target contrast based upon sun/observer geometry. Inherent contrast calculations can be made for two types of sky conditions: overcast sky (no direct sunlight) and clear sky (direct sunlight). Note that both conditions imply a uniform background.

INPUT: The engagement definitions for the SEARCH model are input by the user. These inputs relate to target size and contrast, atmospheric visibility, scenario geometry, size of search field, number of observers, and parameters describing optical aids, should such aids be employed.

OUTPUT: Visual acquisition can be lost when the target becomes very difficult to see; for example, if it passes in front of the sun. This factor is included in the model. Thus it is possible, after accumulating some probability of detection, for the cumulative probability to drop to zero and then begin climbing again because of sun angles. Therefore, the precise interpretation of the model output is, at each point in time, the probability that the target is currently being seen.

HARDWARE AND SOFTWARE:
- Computer: CDC Cyber 74.
- Storage: 75,000 Octal words.
- Language: FORTRAN IV (Ada version also available).
- Documentation: User's Manual.

SECURITY CLASSIFICATION: Source Code is Unclassified.

GENERAL DATA:
Time Requirements: Compilation time: 7 seconds; Typical run time: 9 seconds.

Users: ASD/XRM; BDM Corporation; General Dynamics-Electronics Division; Georgia Institute of Technology; Hughes Radar Systems; Loral Advanced Projects; Naval Weapon Support Center; SAIC; U.S. Army SMO, SLCSM-AT; WL/AAWW-3.

TITLE: VOLUME - Engageability Volume Model Graphic Display.

DATE IMPLEMENTED: 1984.

MODEL TYPE: Analysis, but also useful for training and education.

PROPONENT: Vitro Corporation, 14000 Georgia Ave., Silver Spring, MD 20906.

POINT OF CONTACT: A.J. Ondrish, (301) 231-2097.

PURPOSE: VOLUME is used to generate and produce slides and viewgraphs for presentations and training programs. It serves as a useful aid for visualizing and understanding missile capability from a spatial point of view.

DESCRIPTION:

Domain: Air; at sea for naval ships.

Span: Worldwide.

Environment: Above sea surface.

Force Composition: Ship with STANDARD Missile (SM) versus a target aircraft or missile.

Scope of Conflict: Conventional.

Mission Area: AAW.

Level of Detail of Processes and Entities: VOLUME generates 3-dimensional (3D) representations of SM simulation results, which are combined with 3D solid modeling techniques to present regions of capability in target crossrange and downrange coordinates. Several graphical formats are available, as is the option of arbitrary points of view.

CONSTRUCTION:

Human Participation: Required.

Time Processing: Static.

Treatment of Randomness: Deterministic.

Sidedness: Two-sided.

LIMITATIONS: Portrays only nondiving targets.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Portrayal of diving targets in addition to nondiving targets.

INPUT: Missile type and target speed.

OUTPUT: Graphics display and hardcopies from printer.

HARDWARE AND SOFTWARE:

Computer: HP 9845 C/HP 9020C.
Storage: 150K Bytes.
Peripherals: Roster printer.
Language: HP Rocky Mountain Basic.
Documentation: Notes.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1300 lines of code.

CPU time per Cycle: 70 seconds on HP9845C or 15 seconds on HP 9020C.

Data Analysis Output: Hardcopy graphics.

Frequency of Use: Occasionally.

Users: Vitro uses VOLUME as an additional analysis tool.

Comments: VOLUME is an excellent graphical tool for engageability studies.

TITLE: VWOR - Velocity Walk-Off Response.

DATE IMPLEMENTED: 1987.

MODEL TYPE: Analysis.

PROPONENT: ITT Avionics, 390 Washington Avenue, Nutley, NJ 07110-3697.

POINT OF CONTACT: William High, ITT Avionics, (201) 284-2870.

PURPOSE: To analyze effects of ECM on a frequency tracking loop (CSMP Model).

DESCRIPTION: The model was created using the Continuous Systems Modeling Program. It consists of a set of data records which describe the model as connected analog blocks (integrators, summers, gains, etc.). Some blocks are modeled directly with user supplied FORTRAN subroutines. The model simulates the components of the frequency tracking loop as derived from a laplace transform.

INPUT: Filter characteristic data. Amplitude and phase measurements for discriminators and VCO plus CSMP Model of loop characteristics
.

OUTPUT: Output of frequency tracking loop.

HARDWARE AND SOFTWARE:
- Computer: VAX 11/780-782, requires array processor.
- Storage: 50K Bytes of 8 Bits; memory requirements: 1M Bytes of 8 Bits.
- Language: FORTRAN IV PLUS.
- Documentation: None.

SECURITY CLASSIFICATION: Program without input data is unclassified; input data is secret.

GENERAL DATA:
- Data Base: Typical data preparation is 2 hours.
- CPU time per Cycle: 1 minute.
- Comments: Status of Model - completed, debugged.

THIS PAGE INTENTIONALLY LEFT BLANK

TITLE: WAAM - Worldwide Military Command and Control System (WWMCCS) Allocation and Assessment Model.

DATE IMPLEMENTED: 1983.

MODEL TYPE: Analysis of Command, Control Communications (C3).

PROPONENT: Defense Communications Agency.

POINT OF CONTACT: Dr. Crowley, DCA, (703) 692-5023.

PURPOSE: WAAM has the capability to rapidly assess the emergency action message (EAM) dissemination and performance of the WWMCCS and WWMCCS-based C3 architectures in nuclear stressed environments. It provides a single capability that is responsive to changes (i.e., increases, decreases, improvements, and changes in the U.S. C3 assets) as they may occur and provides a highly credible result. To support the annual SIOP/RISOP war game analysis, WAAM data sets and subroutines are updated to model current MEECN and EAM procedures for executing the SIOP. Numerous simulation excursions are performed to represent varying strategic scenarios and to model adverse conditions that may affect U.S. C3 capabilities. The output from the WAAM functional assessments are analyzed to produce inputs for SINBAC specifying WWMCCS degradation in simulated RED and BLUE nuclear exchanges.

DESCRIPTION: Determines a probability of message receipt by allocation a specified ballistic missile threat to a subset of the WWMCCS as defined by the user, applies the allocation, and determines the direct and collateral damage to the elements of the WWMCCS and outputs a time-ordered probability of damage file. The probabilities of survival or probability of correct message receipts are used in Monte Carlo routines to determine the simulated outcome of specific events. The model uses a networking program with an imbedded Monte Carlo technique.

Domain: Models land-, air-, space-, and sea-based C3 systems.

Span: Global.

Environment: N/A.

Force Composition: BLUE C3 with RED strikes and jamming.

Scope of Conflict: Nuclear.

Mission Area: Strategic connectivity.

Level of Detail of Processes and Entities: Models each communication node and path as well as each threat system.

CONSTRUCTION:
Human Participation: Not required.

Time Processing: Event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: N/A.

PLANNED IMPROVEMENTS AND MODIFICATIONS: N/A.

INPUT: RISOP BLUE Target Base Strike Files Extract for C3 damage; current C3 data base (strategic connectivity master plan data base extract); RISOP high-altitude burst allocation file; C3 systems descriptions/capabilities; and specific case parameters.

OUTPUT: Model output is a single iteration message-routing described in terms of length of time to complete transmission, path of message transmittal, and mode of transmission. This single iteration is replicated a designated number of times to effectively employ the Monte Carlo technique.

HARDWARE AND SOFTWARE:
- Computer: IBM 4341 and VAX 8700.
- Storage: N/A.
- Peripherals: N/A.
- Language: FORTRAN 77.
- Documentation: WAAM overview and user's guide, Feb 1987; WAAM subroutine documentation, Aug 1986.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: 1 month.

CPU time per Cycle: 1 month.

Data Output Analysis: 1/2 month.

Frequency of Use: Annual cycle.

Users: J-8, DCA, OSD PA&E, JDSSC.

Comments: N/A.

TITLE: WAM - Weapon Assessment Model.

DATE IMPLEMENTED: October 1983.

MODEL TYPE: Analysis.

PROPONENT: The BDM Corporation, 7915 Jones Branch Drive, McLean, VA 22102.

POINT OF CONTACT: Edmund J. Bitinas, (703) 848-5246 or John Chalecky, (703) 848-6374.

PURPOSE: WAM is designed to evaluate air-to-surface and surface-to-surface weapon system's capability to defeat a target.

DESCRIPTION:

Domain: Land and sea.

Span: Can accommodate a target array composed of any number of individual elements.

Environment: Elements of the target array exist in a Cartesian coordinate system.

Force Composition: Any mix of forces may be portrayed.

Scope of Conflict: Conventional, advanced conventional, chemical, and nuclear weapons and mines.

Mission Area: Any mission area in which a weapon is used to engage a surface target.

Level of Detail of Processes and Entities: Individual submunitions versus individual target elements (vehicles, personnel, etc.) are considered. Time is not explicitly considered and therefore no processes are explicitly modeled.

CONSTRUCTION:

Human Participation: Not permitted.

Time Processing: Static.

Treatment of Randomness: Weapon hitpoints are determined stochastically through Monte Carlo draws from distributions of delivery system error at all levels (e.g., aircraft delivery error, dispenser ballistic error, and submunition dispersion). Probability of kill for any target element is a function of its distance from the weapon hitpoint. Target element kills are determined in a Monte Carlo fashion based on the computed probability of kill.

Sidedness: One-sided.

LIMITATIONS: Does not consider persistent effects.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Incorporation of algorithms to assess the effects of partial vehicle kills on a combat units overall effectiveness; i.e., interdiction kill methodology.

INPUT: Requirements include the target array, attack system parameters such as target locations errors, system delivery errors, footprint dimensions for smart weapons, and pK curves for different target types within the target array.

OUTPUT: Distributions of the number of target acquisitions (for sensor-fuzed weapons), number of hits on target elements, and number of kills within the target array. Graphic output of a weapon laydown over the target array is also available.

HARDWARE AND SOFTWARE:
- Computer: Runs on the DEC VAX series (VMS), IBM PCs and compatibles (DOS), and the Macintosh family.
- Storage: 200 KB.
- Peripherals: No special requirements for analysis purposes. If graphic output is desired, a graphics capable terminal or plotter is required.
- Language: FORTRAN.
- Documentation: A user's manual is available.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Approximately one man-week.

CPU time per Cycle: Depends on size of attack and number of elements in target array. Run time varies from one minute to twenty minutes on a DEC MicroVAX.

Data Analysis Output: Raw data and summary statistics are provided for ease of interpretation of results.

Frequency of Use: As required; average of six studies per year.

Users: U.S. Air Force, Defense Nuclear Agency, SHAPE Headquarters, Army DCSOPS, commercial concerns.

Comments: Normally employed with other BDM models in a hierarchical modeling approach.

TITLE: WASPS - War-at-Sea Planning System.

DATE IMPLEMENTED: 1988.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resources and Assessment Directorate (J-8).

POINT OF CONTACT: CDR Prima Morris, JCS J-8, Commercial (703) 693-4605.

PURPOSE: WASPS is used to provide decision support capabilities to assist commanders with evaluating alternative Courses of Action for conducting Anti-Surface Warfare (ASUW) operations. The stand-alone system architecture consists of five functional modules; Target Tracking and Predictions, Weaponeering, Route Development, Coordination and Assessment. The modules allow analysts/planners to construct either hypothetical or real world, War-at-Sea, battle force scenarios that contain manned aircraft and/or cruise missiles and evaluate alternative approaches to the accomplishment of a stated objective.

DESCRIPTION:

Domain: Joint Naval, and Air Force, ASUW operations.

Span: Current data base consists of Soviet combatant vessels. Unconstrained theater of operations.

Force Composition: Joint and combined forces, (Air Force and Navy), Blue on Red ASUW Operations.

Scope of Conflict: Conventional warfare, employing standoff weapons, TASM, Harpoon, Harm and gravity bombs.

Mission Area: Anti-Surface Warfare (ASUW) operations only.

Level of Detail of Processes and Entities: WASPS models the interactions between opposing Naval forces in a dynamic War-at-Sea environment. It provides estimates of the expected outcome of a proposed plan. One of two methodologies may be selected, either a discrete-event Monte Carlo simulation or an expected value simulation. The longer running Monte Carlo simulation provides both force level and unit level statistics, while the expected value simulation provides only force level estimates. In either case the Threat Evaluation and Weapon Assignment (TEWA) process for air defense systems is explicitly modeled. Additionally, command and control between defending forces is addressed as is the effects of on-board and stand-off jamming. Also included in the simulation is an airborne interceptor model. The Anti-Air Warfare (AAW) capability models the interactions between hostile Red aircraft interdicting Blue aircraft attacks. Red forces can employ Deck Launched Interceptors, Ground Base Interceptors and Combat Air Patrols, utilizing Air-to-Air Weapons. Blue forces employ escort aircraft from either service (Navy or Air Force) that can utilize advanced Air-to-Air Weapons. A 3-D graphics display and alphanumeric trace report of red and blue interactions is provided along with extensive statistical data to assist planners and analysts in the evaluation of proposed COAs.

CONSTRUCTION:

Human Participation: Required for scenario development only.

Time Processing: Dynamic, time- and event-stepped model. Very scenario dependent, normal operating time is 1-2 hr.

Treatment of Randomness: Random processes include: survivability estimates, damage estimates, variations in environmental conditions, hostile ship locations, anti-ship missile guidance errors.

Sidedness: Two-sided, symmetric, reactive model.

LIMITATIONS: Only evaluates blue ASUW operations. No ASW or Land Attack Warfare areas are addressed.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Model will be enhanced to allow evaluations of Red forces attacking Blue Naval forces.

INPUT: Scenario development utilizing advanced graphical interfaces are used to set up red forces and plan blue attacks. The user determines quantities and routes for aircraft and cruise missiles.

OUTPUT: Produces printed reports of attrition and damage estimates. Over 130 statistical categories of interest are collected. A postprocessing module enables the user to display selected statistical categories across multiple Courses of Action. Reports are selectable by category at the Macro and Micro level, and virtually eliminates the need for large output reports.

HARDWARE AND SOFTWARE:

Computer:	Designed to run on a VAX computer with a VMS operating system.
Storage:	120,000 blocks (60 megabytes).
Peripherals:	Minimum requirements: 1 graphics suite, 1 VT220, 1 printer.
Language:	FORTRAN 77.
Documentation:	Users Manual.

SECURITY CLASSIFICATION: Source Code is unclassified; data base is classified Secret.

GENERAL DATA:

Data Base: Derived from multiple sources, 90% complete.

CPU time per Cycle: Scenario dependent.

Data Output Analysis: Postprocessing aids are provided.

Frequency of Use: Varies at installation sites, but is used at least several times a year.

Users: USCINCPACFLT, NOSC, USCINCPAC.

Comments: None.

TITLE: WEBS - Weapon Effectiveness Battle Simulation.

DATE IMPLEMENTED: 1981.

MODEL TYPE: Analysis.

PROPONENT: CA4 Division, RARDE, Fort Halstead, Sevenoaks, Kent, England.

POINT OF CONTACT: P.R. Syms, RARDE ext. 2452.

PURPOSE: Evaluation of Direct Fire land systems at the battlegroup (battalion) level.

DESCRIPTION:
Domain: Land.

Span: Local, tactical.

Environment: Stochastic terrain, using statistics gathered from runs of BGWG (q.v.) and (in near future) JANUS/BGWG (q.v.).

Force Composition: Heterogeneous mechanized forces.

Scope of Conflict: Conventional.

Mission Area: Direct fire battle. Typically, a 10km front.

Level of Detail of Processes and Detail: Individual vehicles and GW teams represented.

CONSTRUCTION:
Human Participation: No.

Time Processing: Event sequenced.

Treatment of Randomness: Stochastic.

Sidedness: Two-sided, fully symmetric.

LIMITATIONS: Limited ability to update tactics during a run. No ability to represent infantry, barriers or fixed wing aircraft. Terrain and routes are represented in an abstract manner, such that movement routes are constrained to East-West and North-South. No theoretical limit on unit numbers, but practically 120 Blue/300 Red.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Ability to transfer scenarios from JANUS/BGWG. Also minor model changes planned to some areas including target selection.

INPUT: 1) vehicle and weapon characteristics; 2) minefield and artillery mission data; 3) Orbat, deployment, orders and tactics; 4) probability data.

OUTPUT: 1) killer/Victim tables; by replication and averaged; 2) firer/target tables, by replication and averaged; 3) individual events on request.

HARDWARE AND SOFTWARE:

Computer(OS):	DEC 11/750 & 6000 series computers; VAX/VMS.
Storage:	Typically 200 blocks input data for a battlegroup scenario, 6000 blocks executable code. Output files anywhere from a few blocks to 20000 blocks, depending on amount of information requested.
Peripherals:	Disk storage, line printer, etc.
Language:	FORTRAN 77. Some utilities written in Pascal.
Documentation:	4 volumes (User & programmers' guides, model definitions and exec. summary. Updated with model).

SECURITY CLASSIFICATION: Software is unclassified.

GENERAL DATA:

Data Base: Preparation: a few hours to several weeks.

CPU time per Cycle/Data Output Analysis: Preprocessor: none; Simulation: approx. real time, highly dependent on machine and battle size; Analysis package: yes.

Frequency of Use: In constant use. (Has experienced a renaissance since simulation data last collected.)

Users: CA4 RARDE. TRAC (WSMR) and AMSAA (APG) have older versions; it is unknown what use they make of them. DSc(L) MOD will possibly be using WEBS in the near future in place of SLEW (q.v.).

TITLE: WWMCCS/WAAM - Worldwide Military Command and Control System/Allocation and Assessment Model.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: Defense Information Systems Agency, Code TVAB, 3701 N. Fairfax Drive, Arlington, VA 22203-1713.

POINT OF CONTACT: Mr. Brad Stubbs, DSN 226-1837, Commercial (703) 696-1837.

PURPOSE: WAAM is a research and evaluation tool for assessing the effectiveness of current and potential communications systems in disseminating Emergency Action Messages (EAMs) to strategic forces in a nuclear stressed environment. It provides a realistic assessment of the changes in overall strategic C3 system performance in response to changes in equipment, procedures or operational posture within the context of a user defined threat.

DESCRIPTION:

Domain: Models land-, air-, space-, and sea-based C3 systems.

Span: Global with coupled with appropriate data bases.

Environment: Includes time of day and year and other environmental factors related to communications such as solar flux, ground conductivity and naturally occurring radio noise.

Force Composition: C3 to Blue strategic forces with Red strikes and jamming.

Scope of Conflict: Nuclear.

Mission Area: Strategic connectivity.

Level of Detail of Processes and Entities: Individual communications nodes with multiple types of communications equipments, individual message processing activities within a node as well as movement of mobile C3 elements are all explicitly modeled. Red weapon detonations, node damage, and success of message transmissions are Monte Carlo based.

CONSTRUCTION:

Human Participation: Not Required.

Time Processing: Dynamic, event-step.

Treatment of Randomness: Stochastic, Monte Carlo.

Sidedness: One-sided.

LIMITATIONS: Number of simultaneous message injection times limited to 16. Supporting data bases currently in existence are largely limited to strategic C3 and EAM message processing.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Code is being developed to make modeling of message processing less specific to EAMs. X-Windows graphical user interface for model input and output also under development. Additional strategic C3 systems will be incorporated as details become available.

INPUT: Description of C3 nodes and equipments, links and networks, communications procedures, Red burst locations and jammers, timeframe of interest, and message injection times.

OUTPUT: Printouts of message arrival times for both individual force nodes and in aggregate, message paths, and link performance and utilization. Multiple postprocessor graphics to aid analyst in reducing data.

HARDWARE AND SOFTWARE:

Computer:	Sun Sparc 400, Sun SparcStation 1+.
Storage:	150M Bytes (source, executable and storage for results).
Peripherals:	Uses DISSPLA for output graphics.
Language:	FORTRAN, Ada, (w/ "C" for some Sun-specific portions), ORACLE RDBMS used to create many input files.
Documentation:	User's Guide and Overview, Annotated source code listings.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Development of data bases for other than strategic nuclear C3 would require several man-years of effort. Excursions from existing data bases relatively straightforward.

CPU time per Cycle: Varies with size of problem and level of threat. Approximately 2 to 5 minutes per replication for a 300 node network under a RISOP type attack.

Data Output Analysis: Postprocessor routines essential to reduce large amount of output. Graphics markedly assist identification of key issues.

Frequency of Use: Varies but used at least several times a year for extensive numbers of cases.

Users: DISA/TVAB, DISA/JNSS, JSTPS.

Comments: Graphical user interface will make model far easier for user to use, but will make model much more platform specific.

TITLE: XSTAR.

DATE IMPLEMENTED: July 30, 1991.

MODEL TYPE: Analysis.

PROPONENT: Force Structure, Resource, and Assessment Directorate (J-8), The Joint Staff, The Pentagon, Rm 1D937, Washington, DC 20318-8000.

POINT OF CONTACT: Major J. V. Rogers, J-8 NFAD/SDB, (703) 695-4657, AV 225-4657.

PURPOSE: XSTAR is a systems analysis level model used to investigate various system-level effectiveness measures for strategic defense systems.

DESCRIPTION:
Domain: Land- and space-based kinetic energy weapons and space-based directed energy weapon systems.

Span: Single-sided, worldwide strategic defense engagements.

Environment: Three-dimensional, earth-centered coordinate system.

Force Composition: RED offensive missile threat and BLUE strategic defense system (or vice versa).

Scope of Conflict: Strategic offensive nuclear/defensive exchange analysis.

Mission Area: Strategic conflict.

Detail of Level of Processes and Entities: Lowest level of engagement is defensive interceptor to re-entry vehicle. Kills are assessed through Monte Carlo techniques using an overall defined probability of kill of the type of engagement and flight phase of the threat element.

CONSTRUCTION:
Human Participation: Analyst selects decision criteria that involve shot selection by the battle manager function. Model can be run interactively via menus, but is usually run in a batch mode.

Time Processing: Dynamic, time-step (increment is user-defined).

Treatment of Randomness: Weapon systems failures and engagement outcomes are assessed through Monte Carlo determination.

Sidedness: One-sided, nonreactive.

LIMITATIONS: Battle manager has perfect global status information on all threat elements. Sensors are only indirectly modeled in discrimination methodology for midcourse or implicitly in probability of kill values.

PLANNED IMPROVEMENTS AND MODIFICATIONS: Better sensitivity for TMD engagements.

INPUT: Scenario/strike tape of offensive threat, missile parameter file, launch and target site files, computation control file, weapons parameter file, satellite shells file, ground-launched interceptor file, and battle management options.

OUTPUT: User-defined selection of available output reports.

HARDWARE AND SOFTWARE:

Computer:	VAX, SUN 3, or better.
Storage:	800 blocks to store executable image; 300 blocks data files; 30 million bytes virtual memory (60,000 pages).
Peripherals:	None required; terminal or line printer for report review.
Language:	VAX FORTRAN/SUN FORTRAN.
Documentation:	User's guide.

SECURITY CLASSIFICATION: Unclassified.

GENERAL DATA:

Data Base: Currently supported by user-generated flat files. Conversion program exists to take SDIO generated scenario into XSTAR format.

CPU time per Cycle: Depends on launch duration, size of offensive threat, and number of defensive satellites. Typical run times are less than 30 minutes. Five to 15 CPU minutes required for typical representative run (less than 10000 RVs and 500 satellites).

Data Output Analysis: Postprocessor pulls data from output reports into spreadsheet summary files to compare results across multiple runs.

Frequency of Use: Used weekly.

Users: The Joint Staff/J-8 NFAD.

Comments: None.

TITLE: YAC - Yet Another CHEMCAS.

DATE IMPLEMENTED: 1986.

MODEL TYPE: Analysis.

PROPONENT: CRDEC, Studies & Analysis Office, Aberdeen Proving Ground, MD 21010-5423.

POINT OF CONTACT: Mr. Richard Saucier, (301) 278-6721, AV 298-6318.

PURPOSE: This program simulates a one-sided battlefield scenario of firing multiple chemical munitions onto a battlefield sector composed of many target elements. Statistics are calculated for chemical agent casualties and area coverage for each of these target elements. The CHEMCAS model served as the basic structure for the development and building of YAC. The two models differ mainly in their casualty assessment techniques.

DESCRIPTION:

Domain: Land.

Span: Target sector.

Environment: Steady-state meteorological conditions for any time of day or night over flat, open terrain, and static battlefield environment for target location and unit operations.

Force Composition: Simulates effects of either BLUE or RED fighting units.

Scope of Conflict: Chemical warfare.

Mission Area: Assesses chemical missions within combat target areas of platoon to battalion size.

Level of Detail of Processes and Entities: High resolution simulation of the chemical pattern laydowns, target positioning, and assessment of target casualties. Effects of MOPP status and changes in MOPP states and breathing rates also evaluated.

CONSTRUCTION:

Human Participation: Not required for decisions and processes after inputs are setup and program executes; internal control makes decisions and runs.

Time Processing: Model takes snapshots of battlefield situation at specific time intervals or periods.

Treatment of Randomness: The model assumes uniform random distribution of impacts over the targeted area. This assumption is more appropriate for mass firing of RED on BLUE targets, but the reverse can also be assessed. NUSSE3 serves as the deterministic single munition cloud generator.

Sidedness: Program simulates a one-sided battlefield scenario.

LIMITATIONS: The model is limited to steady-state MET conditions over flat, open terrain. The impact generator does not realistically simulate individual munition delivery errors. There are no off-target effects assessments. A limited agent toxicity data base is built into the model. The program remains in a state of initial development, and has served as a research model that has had limited testing and verification of results.

PLANNED IMPROVEMENTS AND MODIFICATIONS: No plans for improvements modifications, or further testing of this program exist.

INPUT: Sector size, size of each subtarget element within the sector, a grid of dosage and deposition values from the single munition source generator NUSSE, breathing rates and MOPP states of each target element, and the number of rounds fired at each target element.

OUTPUT: Statistics on the percent of expected casualties and percent area coverage for each target element are graphically displayed on the console and printed out in tabular form.

HARDWARE AND SOFTWARE:

Computer:	Generalized design and coding permits model to be run on several computers, such as VAX, UNIVAC, IBM, and IBM PC compatible type computer systems.
Storage:	Approximately 9000 lines of code.
Peripherals:	Minimum requirement: one printer.
Language:	ASCII Standard FORTRAN 77.
Documentation:	There is no technical report that documents this methodology, but a small pamphlet exists that serves as a user's guide.

SECURITY CLASSIFICATION: Unclassified, but some data bases, which serve as inputs, may be classified.

GENERAL DATA:

Data Base: Setting up of a sector target array is time-consuming. However, standardized scenarios exist. Time required for setting up of the NUSSE3 cloud inputs depends on availability of agent and munition parameters. Data setup time requirements can vary from minutes to hours.

CPU time per Cycle: The YAC program consists of four separate and independently run modules. Output from one serves as input to the next module in the sequence. The total time for completing an initial run of the YAC series modules may take from one hour to a half a day.

Data Analysis Output: No postprocessor to analyze the output results.

Frequency of Use: Program has become outdated and rarely used. It is being replaced by the newly improved PARACOMPT and MCAS (version of Tech/Map currently being developed within our office) models.

Users: CRDEC.

Comments: None.